

FINAL REPORT

Energy Savings Opportunity Survey Fort Leonard Wood, Missouri

EXECUTIVE SUMMARY

19971023 156

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*Department of the Army
US Army Corps of Engineers
Kansas City District*



Contract No. DACA41-85-C-0112

May, 1987



Energy Masters Corporation

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FORT LEONARD WOOD
CONTRACT NO. DACA41-85-C-0112

VOLUME

TABLE OF CONTENTS

EXECUTIVE SUMMARY

| | |
|--------------------------------|-------|
| 1. Introduction | EX-1 |
| 2. Volume Listing | EX-2 |
| 3. Purpose | EX-3 |
| 4. Brief Scope of Work | EX-4 |
| 5. Procedure | EX-5 |
| 6. Summary and Recommendations | EX-8 |
| A. ECO Relative Priority | EX-10 |
| B. Project Savings Summary | EX-11 |
| C. Energy Consumption Graphics | EX-12 |
| D. Project/Building Chart | EX-13 |
| E. ECO Summaries | EX-18 |
| F. ECO/Building Chart | EX-70 |
| G. Complete Building List | EX-78 |

EXECUTIVE SUMMARY

INTRODUCTION

This report is the final submittal for work performed under Contract No. DACA41-85-C-0112 consisting of an Energy Savings Opportunity Survey (ESOS) performed at Fort Leonard Wood for all buildings listed in Table 1 of this volume and expanded to include the total 275 buildings listed in Table 3.

This report contains recommendations for the reduction of facility energy consumption in accordance with the U.S. Army's directives to produce facilities that operate as energy efficiently as possible while maintaining operational readiness. The survey was performed under the Energy Engineering Analysis Program (EEAP).

The objective of this study is the analysis and recommendations for energy conservation opportunities (ECOs). A summary of the recommended ECOs for all buildings is presented as Table 2 of this volume.

VOLUME LISTING

This report has been divided into 5 separately bound volumes.

A. UNNUMBERED VOLUME

Title: Executive Summary

Contents: Complete Project Summary

B. VOLUME I

Title: Energy Conservation Opportunities (ECOs)

Contents: Executive Summary, Project Narrative, ECO Summaries and Recommendations, Individual building descriptions and building savings summaries.

C. VOLUME II

Title: Calculations

Contents: Evaluation of each ECO/building combination, individual building heating and cooling load calculations and the project contract and meeting minutes.

D. VOLUME III

Title: Site Survey Data

Contents: Data obtained during the site survey and used in the formulation of the project ECOs.

Volume III has limited distribution. Copies have been provided to the DEH and the Kansas City District only.

E. VOLUME IV

Title: Programming Documents

Contents: Programming documents for recommended ECIP, PECIP, QRIP and OSD PIF projects for the installation of qualified ECOs.

PURPOSE

The purpose of this Energy Savings Opportunity Survey (ESOS) is to:

1. Review the previously completed energy studies accomplished for Fort Leonard Wood.
2. Perform a limited site survey, evaluate the facilities with respect to selected Energy Conservation Opportunities (ECOs), and identify any other feasible ECOs for recommendation.
3. Provide programming documentation for projects developed to implement the recommended ECOs.

BRIEF SCOPE OF WORK

The following outline is a brief description of work performed during the preparation of this report. The complete scope of work text as issued by the Corps of Engineers is included in Volume II, Section IX of this report.

1. Review for general information the previously completed Energy Engineering Analysis Program (EEAP) study and all other energy studies which were performed at the Fort Leonard Wood installation.
2. Evaluate selected Energy Conservation Opportunities (ECOs) to determine their energy savings potential and economic feasibility.
3. Perform a limited site survey of selected buildings to insure that any new methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.
4. Provide complete new programming or implementation documentation for all recommended ECOs.
5. Prepare a comprehensive report to document the project.

PROCEDURE

Initial work on this project began with the entry interview conference held with the U.S. Army Corps of Engineers, Kansas City District and Director of Engineering and Housing at Fort Leonard Wood on December 3, 1985. This meeting along with all subsequent meetings served to clarify and/or amend various items in the Scope of Work and update the Corps with progress reports as the work was completed.

A. FIELD SURVEY

Numerous field visits were made to the Fort Leonard Wood facility during the ensuing 18 months in an effort to gather all information required to ensure adequate evaluation of our energy saving recommendations.

There are a total of 275 buildings included in this report. Many of these buildings are very similar in construction and equipment types.

A limited site survey was conducted to develop savings calculations and recommendations for 61 typical buildings. This survey began with a careful analysis of available construction plans and specifications. Inspections of the buildings were then made, and in addition to the data gathered for specific ECO calculations, the following observations were recorded.

- a. Building personnel were interviewed to determine the building operating schedules and current use.

- b. The HVAC equipment type, location and general operating condition.
- c. Measured amps and voltage on major HVAC equipment including air handlers, pumps and chillers.

B. OFFICE ANALYSIS

After completion of the field survey portion of the project, data was evaluated in our Overland Park, Kansas office to qualify and prioritize ECOs in accordance with ECIP guidelines for the development of projects for funding.

Individual building ECOs were considered based on information obtained during the limited site survey.

ECOs that were considered infeasible were listed in the report with reasons for elimination. ECOs recommended for implementation were described in the report. Cost estimated, energy savings calculations, and economic analysis were prepared and included for each ECO/Building combination.

C. UTILITY COSTS

1. Electricity

The electrical energy cost which was used for energy saving calculations is \$20.575/MBTU for Region 7, in accordance with the June 1986 ECIP Guidance.

Based on discussion at the Interim Review Conference, it was decided to use the regional utility prices rather than local prices.

Using the same ratio as Regional average KWH cost to Local KWH cost, an estimated Regional Demand Charge of \$9.662/KWH/month has been calculated for use in demand but not energy saving ECOs.

2. LP Gas

Liquid petroleum gas is not addressed in the ECIP guidance manual, so actual local delivered fuel cost of \$0.4655/gal was used in the savings calculations. This equals 4.90 \$/MBTU at 95,000 BTU/Gallon.

The ECIP natural gas discount factor was used for life cycle cost computations.

3. # 2 Oil

In accordance with ECIP criteria, the Region 7 fuel cost of 6.203 \$/MBTU was used for savings calculations. The actual local delivered cost is \$0.7798/gal or 5.622 \$/MBTU at a fuel value of 138,7000 BTU/gal.

4. # 6 Oil

In accordance with ECIP criteria, the Region 7 fuel cost of 3.490 \$/MBTU was used for savings calculations. The actual local delivered cost is \$ 0.70/gal or 4.667 \$/MBTU at a fuel value of 150,000 BTU/gal.

SUMMARY AND RECOMMENDATIONS

Nineteen recommended ECOs comprise the 8 projects listed on the Project Savings Summary. Project #6 shows no energy savings, the savings from this chilled water storage project is electric demand charge savings. The ECOs recommended are the following:

| ECO # | ECO TITLE |
|-------|--|
| 1 | Insulation, Masonry Walls |
| 1A | Insulation, Metal Roof |
| 1B | Insulation, Metal Walls |
| 2 | Weather Stripping & Caulking |
| 7 | Reduce DHW Temperature |
| 10 | Replace Incandescent Lighting |
| 11X | Exit Sign Replacement |
| 12 | High Efficiency Motor Replacement |
| 14 | Infrared Heaters |
| 15 | Economizer Cycles (Dry Bulb) |
| 16 | Control DHW Circulation Pump |
| 18 | Decentralize DHW Heaters |
| 21 | Reduce Air Flow |
| 23 | Install Timeclocks & Night Thermostats |
| 31 | Waste Heat Recovery |
| 32 | Thermal Storage (Chilled Water) |
| 34 | Interlock Kitchen Exhaust & Make-up |
| 35 | Fan Controls |

FORT LEONARD WOOD
CONTRACT NO. DACA41-85-C-0112

ECO #7, Reduce Domestic Hot Water (DHW) temperature has been recommended for several buildings, but may be done by adjustment of controls at minimal cost and is therefore recommended as a low cost project. The results have not been extrapolated to include similar buildings because there is not a good correlation between control adjustment and building size or type. This is an item, like space thermostats, that requires occupant cooperation and discipline to be effective.

ECO #33, Steam trap inspection is recommended as a low cost project to be conducted on a continuing basis by maintenance personnel. The scope of this project is unknown, but the cost benefit ratio can be quite good. (SIR of about 6)

The relative priority of each recommended ECO in ECIP SIR sequence is provided in the following chart.

A breakdown of the savings for each ECO is provided in the second chart which identifies the ECO grouping for the recommended projects.

A copy of the savings summary for each ECO identifying the savings per building and a building list for each ECO have also been included in this section.

| ECO NAME | ECO # | ANNUAL MBTU SAVINGS | | | ENERGY COST SAVINGS | NON ENERGY SAVINGS | TOTAL ANNUAL SAVINGS | CONST COST | SIMPLE PAYBACK | SIR | PROJECT COST W/ \$10H | FY89 COST W/ \$10H |
|-------------------|-------|------------------------------------|-----------|-----------|---------------------|--------------------|----------------------|------------|----------------|-------|-----------------------|--------------------|
| REDUCE AIR FLOW | 21 | 0.00 | 0.00 | 0.00 | \$8,850.47 | \$182,098 | \$0 | \$182,098 | \$29,927 | 0.16 | 52.08 | \$31,573 |
| EXIT LIGHT CONV | 11X | 0.00 | 0.00 | 0.00 | 3,313.31 | \$68,174 | \$1,154 | \$69,328 | \$20,768 | 0.30 | 36.79 | \$21,910 |
| DRY BULB ECON | 15 | 0.00 | 0.00 | 0.00 | 2,838.68 | \$58,407 | \$0 | \$58,407 | \$21,780 | 0.37 | 22.95 | \$22,978 |
| REDUCE DHW TEMP | 7 | 46.30 | 11.62 | 3.90 | 2.43 | \$304 | \$0 | \$304 | \$450 | 1.74 | 11.04 | \$475 |
| DHW CIRC PUMP | 16 | 831.08 | 28.16 | 102.34 | 62.13 | \$4,853 | \$0 | \$4,853 | \$11,396 | 2.35 | 6.82 | \$12,023 |
| STEAM TRAP INSPI. | 33 | 29.57 | 0.00 | 0.00 | 0.00 | \$103 | \$0 | \$103 | \$91 | 0.88 | 6.81 | \$98 |
| TIME CLOCKS | 23 | 0.00 | 1,575.10 | 318.62 | 173.30 | \$14,897 | \$0 | \$14,897 | \$25,332 | 1.70 | 6.30 | \$26,725 |
| WASTE HEAT RECOV | 31 | 3,188.36 | 0.00 | 0.00 | -9.69 | \$10,931 | \$0 | \$10,931 | \$43,960 | 4.02 | 4.41 | \$46,378 |
| METAL WALL INS | 18 | 0.00 | 4,804.00 | 0.00 | 0.00 | \$29,800 | \$0 | \$29,800 | \$125,928 | 4.23 | 3.95 | \$132,854 |
| VENT FAN CONTROL | 35 | 0.00 | 0.00 | 0.00 | 43.25 | \$890 | \$0 | \$890 | \$2,107 | 2.37 | 3.62 | \$2,223 |
| REPL INCAND LGTS | 10 | 0.00 | 0.00 | 0.00 | 4,826.83 | \$99,312 | \$0 | \$99,312 | \$308,862 | 3.11 | 3.54 | \$325,849 |
| DEDICATED DHW | 18 | 0.00 | 417.95 | 0.00 | 0.00 | \$2,592 | \$0 | \$2,592 | \$12,952 | 5.00 | 3.34 | \$13,664 |
| HI-EFF MOTORS | 12 | 0.00 | 0.00 | 0.00 | 375.07 | \$7,717 | \$0 | \$7,717 | \$27,351 | 3.54 | 3.11 | \$28,855 |
| KITCH VENT CONTRL | 34 | 1,919.30 | 0.00 | 0.00 | 165.09 | \$10,096 | \$0 | \$10,096 | \$36,034 | 3.57 | 3.03 | \$38,016 |
| INFRARED HEATERS | 14 | 0.00 | 3,699.00 | -1,950.00 | 96.50 | \$15,375 | \$0 | \$15,375 | \$89,630 | 5.83 | 2.46 | \$94,560 |
| WEATHERSTRIP | 2 | 0.00 | 1,168.61 | 188.83 | 40.11 | \$9,000 | \$0 | \$9,000 | \$40,560 | 4.51 | 1.43 | \$42,791 |
| METAL ROOF INS | 1A | 0.00 | 8,088.96 | 0.00 | 0.00 | \$50,175 | \$0 | \$50,175 | \$412,280 | 8.22 | 1.37 | \$434,955 |
| MASONRY WALL INS | 1 | 13,130.34 | 647.56 | 320.90 | 983.32 | \$71,645 | \$0 | \$71,645 | \$863,062 | 12.05 | 1.31 | \$910,530 |
| CHW STORAGE | 32 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 | \$21,403 | \$21,403 | \$70,356 | 3.29 | 3.52 | \$74,226 |
| GRAND TOTAL | | 19,144.95 | 20,440.96 | -1,015.41 | 21,760.80 | \$636,369 | \$22,557 | \$658,926 | \$2,142,826 | 3.25 | | \$2,260,681 |
| | | 60331.30 TOTAL MBTU SAVED PER YEAR | | | | | | | | | | \$2,310,995 |

EX- 10

Revised 8/14/87

FORT LEONARD WOOD

PROJECT SAVINGS SUMMARY

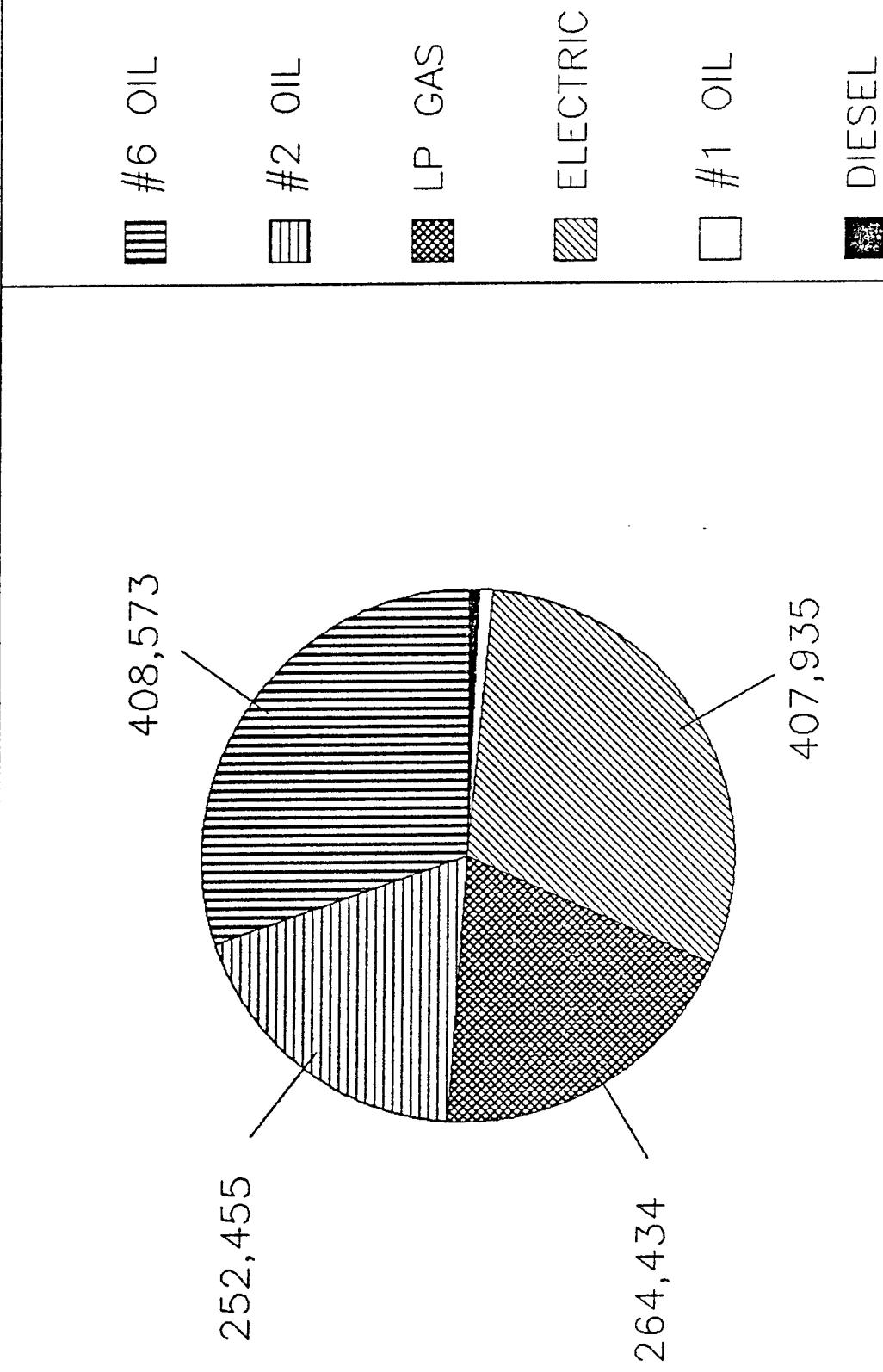
CONTRACT NO DACA41-85-C-0112

| ECO NAME | ECO # | ANNUAL MBTU SAVINGS | | | ENERGY COST SAVINGS | NON ENERGY SAVINGS | TOTAL ANNUAL SAVINGS | CONSTRUCT COST | SIMPLE PAYBACK | SIR | PROJECT COST W/ SLOH | FY89 COST W/ SLOH | FY87 W/ DESIGN & SLOH | |
|---------------------|-----------|---------------------|-----------|-----------|---------------------|--------------------|----------------------|----------------|----------------|-------|----------------------|-------------------|-----------------------|----------|
| PROJECT # & TYPE | # | #6 OIL | #2 OIL | LP GAS | ELECT | | | | | | | | | |
| METAL WALL INS | 1B | 0.00 | 4,804.00 | 0.00 | 0.00 | \$29,800 | \$0 | \$29,800 | 4.23 | 3.95 | \$132,854 | \$135,811 | \$140,410 | |
| METAL ROOF INS | 1A | 0.00 | 8,088.96 | 0.00 | 0.00 | \$50,175 | \$0 | \$50,175 | 8.22 | 1.37 | \$434,955 | \$444,636 | \$459,692 | |
| MASONRY WALL INS | 1 | 13,130.34 | 647.56 | 320.90 | 983.32 | \$71,645 | \$0 | \$71,645 | 12.05 | 1.31 | \$910,530 | \$930,795 | \$962,314 | |
| #1 ECIP | 13,130.34 | 13,540.52 | 320.90 | 983.32 | \$151,620 | \$0 | \$151,620 | \$1,401,270 | 9.24 | 1.76 | \$1,478,340 | \$1,511,242 | \$1,562,416 | |
| WASTE HEAT RECOV | 31 | 3,188.36 | 0.00 | 0.00 | -9.69 | \$10,931 | \$0 | \$10,931 | 4.02 | 4.41 | \$46,378 | \$47,410 | \$49,015 | |
| H1-EFF MOTORS | 12 | 0.00 | 0.00 | 0.00 | 375.07 | \$7,717 | \$0 | \$7,717 | 3.54 | 3.11 | \$28,855 | \$29,498 | \$30,496 | |
| #2 PECIP | 3,188.36 | 0.00 | 0.00 | 365.38 | \$18,648 | \$0 | \$18,648 | \$71,311 | 3.82 | 3.91 | \$75,233 | \$76,907 | \$79,512 | |
| #3 OSD PIF, LIGHTS | 10 | 0.00 | 0.00 | 0.00 | 4,826.83 | \$99,312 | \$0 | \$99,312 | 3.11 | 3.54 | \$325,849 | \$333,101 | \$344,381 | |
| EXIT LIGHT CONV | 11X | 0.00 | 0.00 | 0.00 | 3,313.31 | \$68,174 | \$1,154 | \$69,328 | 0.30 | 36.79 | \$21,910 | \$22,398 | \$23,156 | |
| DHW CIRC PUMP | 16 | 831.08 | 28.16 | 102.34 | 62.13 | \$6,853 | \$0 | \$4,853 | 2.35 | 6.82 | \$12,023 | \$12,290 | \$12,707 | |
| TIME CLOCKS | 23 | 0.00 | 1,575.10 | 318.62 | 173.30 | \$14,897 | \$0 | \$14,897 | 25.332 | 1.70 | \$26,725 | \$27,320 | \$28,245 | |
| VENT FAN CONTROL | 35 | 0.00 | 0.00 | 0.00 | 43.25 | \$890 | \$0 | \$890 | 2.37 | 3.62 | \$2,107 | \$2,223 | \$2,272 | |
| #4 QRIP | 831.08 | 1,603.26 | 420.96 | 3,591.99 | \$88,814 | \$1,154 | \$89,968 | \$59,603 | 0.66 | 18.18 | \$62,881 | \$64,281 | \$66,457 | |
| DRY BULB ECON | 15 | 0.00 | 0.00 | 0.00 | 2,838.68 | \$58,407 | \$0 | \$58,407 | \$21,780 | 0.37 | 22.95 | \$22,978 | \$23,489 | \$24,285 |
| REDUCE AIR FLOW | 21 | 0.00 | 0.00 | 8,850.47 | \$182,098 | \$0 | \$182,098 | \$29,927 | 0.16 | 52.08 | \$31,573 | \$32,276 | \$33,369 | |
| #5 QRIP | 0.00 | 0.00 | 0.00 | 11,689.15 | \$240,505 | \$0 | \$240,505 | \$51,707 | 0.21 | 39.81 | \$54,551 | \$55,765 | \$57,653 | |
| #6 PECIP, CHW STORE | 32 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 | \$21,403 | \$21,403 | \$70,356 | 3.29 | 3.52 | \$74,226 | \$75,878 | \$78,447 |
| WEATHERSTRIP | 2 | 0.00 | 1,168.61 | 188.83 | 40.11 | \$9,000 | \$0 | \$9,000 | \$40,560 | 4.51 | 1.43 | \$42,791 | \$43,743 | \$45,224 |
| INFRARED HEATERS | 14 | 0.00 | 3,699.00 | -1,950.00 | 96.50 | \$15,375 | \$0 | \$15,375 | \$89,630 | 5.83 | 2.46 | \$94,560 | \$96,664 | \$99,937 |
| DEDICATED DHW | 18 | 0.00 | 417.95 | 0.00 | 0.00 | \$2,592 | \$0 | \$2,592 | \$12,952 | 5.00 | 3.34 | \$13,664 | \$13,968 | \$14,441 |
| KITCH VENT CTRL | 34 | 1,919.30 | 0.00 | 0.00 | 165.09 | \$10,096 | \$0 | \$10,096 | \$36,034 | 3.57 | 3.03 | \$38,016 | \$38,862 | \$40,178 |
| #7 MACOM | 1,919.30 | 5,285.56 | -1,761.17 | 301.70 | \$37,063 | \$0 | \$37,063 | \$179,176 | 4.83 | | \$189,031 | \$193,238 | \$199,781 | |
| REDUCE DHW TEMP | 7 | 46.30 | 11.62 | 3.90 | 2.43 | \$304 | \$0 | \$304 | \$450 | 1.74 | 11.04 | \$475 | \$485 | \$502 |
| STEAM TRAP INSP. | 33 | 29.57 | 0.00 | 0.00 | \$103 | \$0 | \$103 | \$91 | 0.88 | 6.81 | \$96 | \$98 | \$101 | |
| #8 LOW/NO COST | 75.87 | 11.62 | 3.90 | 2.43 | \$407 | \$0 | \$407 | \$541 | 1.33 | 12.54 | \$571 | \$583 | \$603 | |

EX- 11

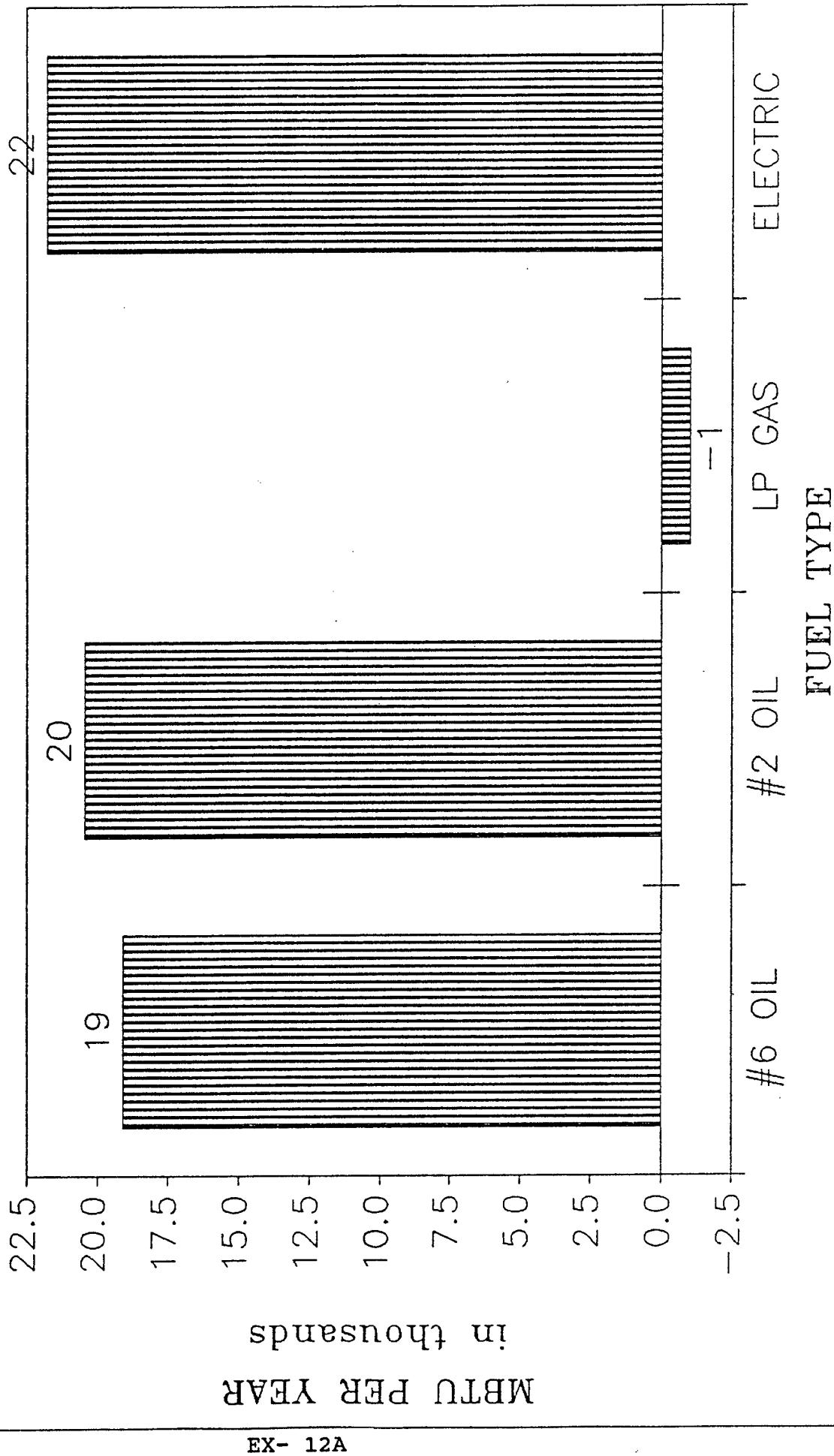
Revised 8/14/87

BASE WIDE ENERGY CONSUMPTION
FY86
MILLION BTU PER YEAR

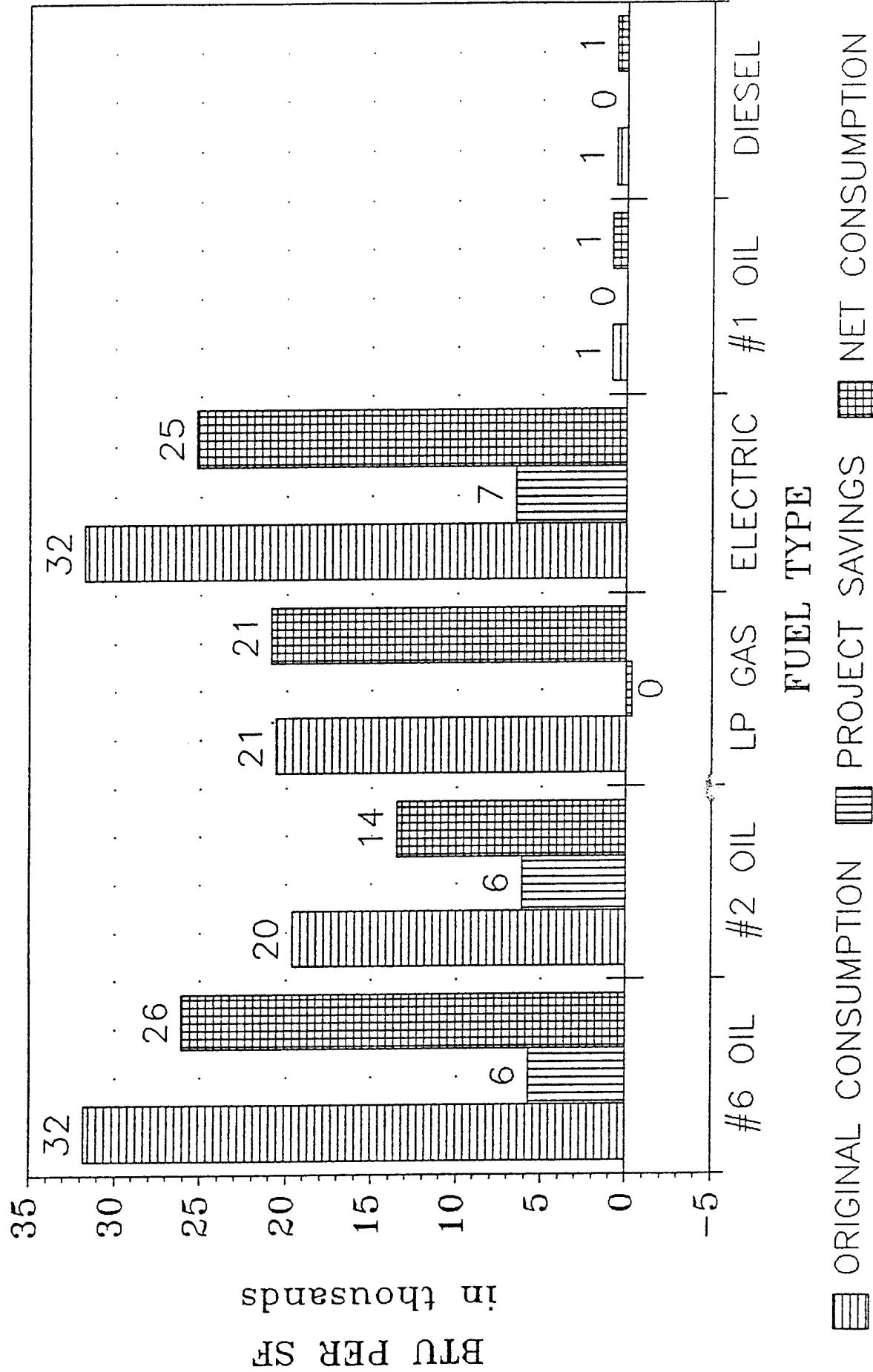


TOTAL PROJECT SAVINGS

MILLION BTU PER YEAR



NET CONSUMPTION PER SQ FT
BTU PER SF PER YEAR



FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

RECOMMENDED PROJECT SUMMARY

| PROJECT FUNDING BUILDING | #1 ECIP | #2 PECIP | #3 OSD PIF | #4 QRIP | #5 QRIP | #6 PECIP |
|--------------------------------|------------|-------------|---------------|------------|------------|-------------|
| 185 | | X | X | X | | |
| 312 | X | | X | X | X | |
| 315 | X | | | X | | |
| 318 | | | | X | | |
| 319 | | | | X | | |
| 320 | | | | | | |
| 450 | | | X | X | | |
| 499 | X | | X | X | X | X |
| 500 | | X | X | X | X | |
| 561 | X | | | | | |
| 562 | X | | | | | |
| 563 | X | | | | | |
| 564 | X | | | | | |
| 565 | X | | | | | |
| 565 | X | | | | | |
| 566 | X | | | | | |
| 567 | X | | | | | |
| 568 | X | | | | | |
| 569 | X | | | | | |
| 625 | X | | X | X | X | |
| 626 | X | | X | X | X | |
| 627 | X | | X | X | X | |
| 628 | X | | X | X | X | |
| 629 | X | | X | X | X | |
| 630 | X | | X | X | X | |
| 631 | X | | X | X | X | |
| 633 | X | | X | X | X | |
| 634 | X | | X | X | X | |
| 635 | X | | X | X | X | |
| 636 | X | | X | X | X | |
| 638 | X | | X | X | X | |
| 650 | X | | X | X | X | |
| 651 | X | | X | X | X | |
| 652 | X | | X | X | X | |
| 653 | X | | X | X | X | |
| 654 | X | | X | X | X | |
| 655 | X | | X | X | X | |
| 656 | X | | X | X | X | |
| 657 | X | | X | X | X | |
| 658 | X | | X | X | X | |
| 659 | X | | X | X | X | |
| 660 | X | | X | X | X | |
| 664 | X | | | | | |
| 665 | X | | | | | |
| 666 | X | | | | | |
| 667 | X | | | | | |
| 668 | X | | | | | |
| 669 | X | | | | | |
| 672 | | | X | | X | |
| 673 | | | X | | X | |
| 680 | | | X | | X | |
| 681 | | | X | | X | |
| 686 | X | | | | | |
| 687 | X | | | | | |
| 688 | X | | | | | |
| 689 | X | | | | | |
| 690 | X | | | | | |
| 691 | X | | | | | |
| 692 | X | | | | | |
| 693 | X | | | | | |
| 694 | X | | | | | |
| 701 | X | | | | | |
| 702 | X | | | | | |
| 703 | X | | | X | | |

EX

Revised 8/14/87

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

RECOMMENDED PROJECT SUMMARY

| PROJECT FUNDING BUILDING | #1 ECIP | #2 PECIP | #3 OSD PIF | #4 QRIP | #5 QRIP | #6 PECIP |
|--------------------------------|------------|-------------|---------------|------------|------------|-------------|
| 704 | X | | | | | |
| 705 | X | | | | | |
| 706 | X | | | | | |
| 707 | X | | | | | |
| 709 | X | | | | | |
| 710 | X | | | | | |
| 711 | X | | | | | |
| 712 | X | | | | | |
| 713 | X | | | | | |
| 713 | X | | | X | | |
| 714 | X | | | | | |
| 715 | X | | | | | |
| 716 | X | | | | | |
| 717 | X | | | | | |
| 718 | X | | | | | |
| 719 | X | | | | | |
| 720 | X | | | | | |
| 721 | X | | | | | |
| 722 | X | | | X | | |
| 723 | XX | | | | | |
| 724 | XX | | | | | |
| 725 | XX | | | | | |
| 726 | XX | | | | | |
| 727 | XX | | | | | |
| 728 | XX | | | | | |
| 730 | XX | | | | | |
| 731 | XX | | | | | |
| 732 | XX | | | | | |
| 733 | XX | | | | | |
| 734 | XX | | | | | |
| 735 | XX | | | | | |
| 736 | XX | | | | | |
| 738 | XX | | | | | |
| 739 | XX | | | | | |
| 740 | XX | | | | | |
| 741 | XX | | | | | |
| 743 | XX | | | | | |
| 747 | XX | | | | | |
| 748 | XX | | | | | |
| 749 | XX | | | | | |
| 750 | XX | | | | | |
| 751 | XX | | | | | |
| 752 | XX | | | | | |
| 753 | XX | | | | | |
| 754 | XX | | | | | |
| 755 | XX | | | | | |
| 756 | XX | | | | | |
| 758 | XX | | | | | |
| 759 | XX | | | | | |
| 760 | XX | | | | | |
| 761 | XX | | | | | |
| 762 | XX | | | | | |
| 763 | XX | | | | | |
| 764 | XX | | | | | |
| 765 | XX | | | | | |
| 766 | X | | | | | |
| 772 | | | | X | | |
| 773 | | | | XX | | |
| 780 | | | | X | | |
| 781 | | | | XX | | |
| 790 | X | | | | | |
| 791 | XX | | | | | |
| 792 | XX | | | X | | |
| 793 | X | | | | | |

EX

Revised 8/14/87

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

RECOMMENDED PROJECT SUMMARY

| PROJECT FUNDING BUILDING | #1 ECIP | #2 PECIP | #3 OSD PIF | #4 QRIP | #5 QRIP | #6 PECIP |
|--------------------------------|------------|-------------|---------------|------------|------------|-------------|
| 794 | X | | | | | |
| 795 | X | | | | | |
| 796 | X | | | | | |
| 797 | X | | | | | |
| 798 | X | | | | | |
| 801 | | | | | | |
| 806 | X | | | | | |
| 807 | X | | | | | |
| 808 | X | | | | | |
| 809 | X | | | | | |
| 810 | X | | | | | |
| 811 | X | | | X | | |
| 812 | X | | | | | |
| 813 | X | | | | | |
| 814 | X | | | | | |
| 815 | X | | | | | |
| 816 | X | | | | | |
| 817 | X | | | | | |
| 818 | X | | | | | |
| 819 | X | | | | | |
| 820 | X | | | | | |
| 821 | X | | | | | |
| 822 | X | | | | | |
| 823 | X | | | | | |
| 824 | X | | | | | |
| 825 | X | | | | | |
| 827 | X | | | | | |
| 828 | X | | | | | |
| 829 | X | | | | | |
| 830 | X | | | | | |
| 831 | X | | | | | |
| 832 | X | | | | | |
| 836 | X | | | | | |
| 838 | X | | | | | |
| 840 | X | | | | | |
| 841 | X | | | | | |
| 842 | X | | | | | |
| 851 | X | | | | | |
| 852 | X | | | | | |
| 853 | X | | | | | |
| 854 | X | | | | | |
| 855 | X | | | | | |
| 856 | X | | | | | |
| 857 | X | | | | | |
| 858 | X | | | | | |
| 859 | X | | | | | |
| 990 | | | | | | |
| 991 | | | | | | |
| 998 | | | | | | |
| 999 | | | | | | |
| 1006 | X | | | | | |
| 1007 | X | | | | | |
| 1008 | X | | | | | |
| 1009 | X | | | | | |
| 1010 | X | | | | | |
| 1011 | X | | | | | |
| 1012 | X | | | | | |
| 1013 | X | | | | | |
| 1014 | X | | | | | |
| 1015 | X | | | | | |
| 1016 | X | | | | | |
| 1018 | X | | | | | |
| 1025 | X | | | | | |
| 1028 | X | | | | | |

EX

Revised 8/14/87

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

RECOMMENDED PROJECT SUMMARY

| PROJECT FUNDING BUILDING | #1 ECIP | #2 PECIP | #3 OSD PIF | #4 QRIP | #5 QRIP | #6 PECIP |
|--------------------------------|------------|-------------|---------------|------------|------------|-------------|
| 1029 | X | | | X | | |
| 1601 | X | X | X | X | X | |
| 1608 | | | X | X | | |
| 1700 | | | | X | | |
| 1701 | | | | X | | |
| 1702 | | | | X | | |
| 1703 | | | | X | | |
| 1704 | | | | X | | X |
| 1705 | | | | X | | |
| 1706 | | | | X | | |
| 1707 | | | | X | | |
| 1720 | | | X | X | | |
| 1722 | | | X | X | | |
| 1723 | | | X | X | | |
| 1724 | | | X | X | | |
| 1725 | | | X | X | | |
| 1726 | | | X | X | | |
| 1728 | | | X | X | | |
| 1729 | | | X | X | | |
| 1730 | | | X | X | | |
| 1731 | | | X | X | | |
| 1732 | | | X | X | | |
| 1733 | | | X | X | | |
| 1734 | | | X | X | | |
| 1735 | | | X | X | | |
| 1740 | | X | | | | X |
| 1750 | | | | X | X | |
| 1761 | | | X | X | | |
| 1762 | | | X | X | | |
| 1763 | | | X | X | | |
| 1764 | | | X | X | | |
| 1765 | | | X | X | | |
| 1766 | | | X | X | | |
| 1767 | | | X | X | | |
| 1768 | | | X | X | | |
| 1769 | | | X | X | | |
| 1771 | | | X | X | | |
| 1773 | | | X | X | | |
| 1774 | | | X | X | | |
| 1775 | | | X | X | | |
| 1776 | | | X | X | | |
| 2240 | | | | | | |
| 2250 | | | | | | |
| 2317 | | | | | | |
| 2347 | | | | | | |
| 2348 | | | | | | |
| 2395 | | | | | | |
| 2399 | | | X | | | X |
| 4100 | X | | | | X | |
| 4101 | XX | | | | X | |
| 4102 | X | | | | X | |
| 4103 | X | | | | X | |
| 4104 | X | | | | X | |
| 4110 | | | | | X | |
| 4111 | | | | | X | |
| 4112 | | | | | X | |
| 4113 | | | | | X | |
| 4114 | | | | | X | |
| 4115 | | | X | | X | |
| 5050 | | | X | | X | |
| 5052 | | | X | | X | |
| 5053 | | | | | X | |
| 5074 | | | | | | X |
| 5122 | | | | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

RECOMMENDED PROJECT SUMMARY

| PROJECT FUNDING BUILDING | #1 ECIP | #2 PECIP | #3 OSD PIF | #4 QRIP | #5 QRIP | #6 PECIP |
|--------------------------------|------------|-------------|---------------|------------|------------|-------------|
| 5130 | | | | | | |
| 5150 | | | | X | | |
| 5161 | | | | X | | |
| 5169 | | | | X | | |
| 5231 | | | | X | | |
| 5301 | | | | X | | |
| 5334 | | | | X | | |
| 5346 | | | | X | | |
| 5350 | | | | X | | |
| 5361 | | | | X | | |
| 5374 | | | | X | | |
| 5391 | | | | X | | |
| 5500 | | | | X | | |
| 5511 | | | | X | | |
| 5531 | | | | X | | |
| 5592 | | | | X | | |
| 5702 | | | | X | | |
| 5732 | | | | X | | |
| 5743 | | | | | X | |
| 10250 | | X | | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #1: Insulation, Masonry Walls

CURRENT SITUATION: (Permanent Buildings)

A. Roof / Ceiling Insulation

The buildings inspected do not have attic spaces where insulation may easily be added. Roof insulation should be considered when the buildings are re-roofed.

B. Wall Insulation

The permanent buildings inspected have double masonry cavity walls without insulation.

These walls may be insulated by drilling holes in the wall and blowing insulation into the cavity. This has been considered for most buildings.

C. Basement Insulation

These cast-in-place concrete walled areas may only be insulated by adding a new interior or exterior wall surface. This was estimated to cost more than \$3.50 per square foot. Insulating these areas was not considered because the basement are generally unoccupied and this would have to be justified based upon comfort because of the long payback.

PROPOSAL:

Install blown in wall insulation in feasible areas where none exists. Expansion of this project to include permanent buildings not in this ESOS should be considered.

ECONOMICS:

The total cost, savings, Savings Investment Ratio (SIR) and simple payback are:

Heating Energy Savings Per Year: \$ 51,415
14,099 MBTU

Electricity Savings Per Year: \$ 20,231
983 MBTU

Total Savings Per Year: \$ 71,646

Total Construction Cost: \$ 863,062

Simple Payback (YRS): 12.05

SIR: 1.31

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 1
INSULATE EXTERIOR WALLS

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | FUEL | OTHER | PROJECT COST | SIMPLE PAYBACK | SIR |
|--------------------|-------------|-------------------------------------|---------------|----------------|--------------|------------------|-------------------|
| | | #6 OIL #2 OIL LP GAS | ELECT | SAVINGS | SAVING | | |
| 499 | 0 | 0.00 72.50 0.00 | 8.68 | \$628 | 0 | \$4,247 | 6.76 2.23 |
| 315 | 0 | 0.00 0.00 320.90 | 30.18 | \$2193 | 0 | \$18,799 | 8.57 1.98 |
| 1601 | 0 | 0.00 133.71 0.00 | 0.00 | \$829 | 0 | \$7,833 | 9.45 1.77 |
| 4102 | 0 | 0.00 67.83 0.00 | 8.70 | \$600 | 0 | \$5,557 | 9.26 1.62 |
| 4102 | 4 | 0.00 271.32 0.00 | 34.80 | \$2399 | 0 | \$22,228 | 9.27 1.62 |
| 743 | 0 | 46.99 0.00 0.00 | 5.78 | \$283 | 0 | \$2,831 | 10.00 1.48 |
| 743 | 3 | 140.97 0.00 0.00 | 17.35 | \$849 | 0 | \$8,493 | 10.00 1.48 |
| 821 | 0 | 81.11 0.00 0.00 | 8.70 | \$462 | 0 | \$4,887 | 10.58 1.42 |
| 636 | 0 | 62.63 0.00 0.00 | 6.06 | \$343 | 0 | \$3,774 | 11.00 1.38 |
| 734 | 0 | 136.26 0.00 0.00 | 13.18 | \$747 | 0 | \$8,210 | 10.99 1.38 |
| 740 | 0 | 8.60 0.00 0.00 | 0.83 | \$47 | 0 | \$518 | 11.02 1.38 |
| 740 | 11 | 94.60 0.00 0.00 | 9.16 | \$519 | 0 | \$5,698 | 10.98 1.38 |
| 741 | 0 | 62.63 0.00 0.00 | 6.06 | \$343 | 0 | \$3,774 | 11.00 1.38 |
| 822 | 0 | 8.60 0.00 0.00 | 0.83 | \$47 | 0 | \$518 | 11.02 1.38 |
| 823 | 0 | 136.26 0.00 0.00 | 13.18 | \$747 | 0 | \$8,210 | 10.99 1.38 |
| 628 | 0 | 271.73 0.00 0.00 | 21.51 | \$1391 | 0 | \$16,374 | 11.77 1.32 |
| 628 | 25 | 6793.25 0.00 0.00 | 537.69 | \$34771 | 0 | \$409,350 | 11.77 1.32 |
| 657 | 0 | 81.11 0.00 0.00 | 6.42 | \$415 | 0 | \$4,887 | 11.78 1.32 |
| 657 | 7 | 567.77 0.00 0.00 | 44.94 | \$2906 | 0 | \$34,209 | 11.77 1.32 |
| 735 | 0 | 81.11 0.00 0.00 | 6.42 | \$415 | 0 | \$4,887 | 11.78 1.32 |
| 1008 | 0 | 41.37 0.00 0.00 | 3.27 | \$212 | 0 | \$2,493 | 11.76 1.32 |
| 1014 | 0 | 295.22 0.00 0.00 | 23.37 | \$1511 | 0 | \$17,789 | 11.77 1.32 |
| 1014 | 5 | 1476.10 0.00 0.00 | 116.84 | \$7556 | 0 | \$88,945 | 11.77 1.32 |
| 1016 | 0 | 295.22 0.00 0.00 | 23.37 | \$1511 | 0 | \$17,789 | 11.77 1.32 |
| 1006 | 0 | 122.63 0.00 0.00 | 10.79 | \$650 | 0 | \$8,210 | 12.63 1.22 |
| 1010 | 0 | 73.80 0.00 0.00 | 6.49 | \$391 | 0 | \$4,941 | 12.64 1.22 |
| 1010 | 1 | 73.80 0.00 0.00 | 6.49 | \$391 | 0 | \$4,941 | 12.64 1.22 |
| 312 | 0 | 0.00 102.20 0.00 | 12.23 | \$886 | 0 | \$11,402 | 12.87 1.17 |
| 655 | 0 | 136.26 0.00 0.00 | 0.00 | \$476 | 0 | \$8,210 | 17.25 1.02 |
| 655 | 11 | 1498.86 0.00 0.00 | 0.00 | \$5231 | 0 | \$90,310 | 17.26 1.02 |
| 747 | 0 | 271.73 0.00 0.00 | 0.00 | \$948 | 0 | \$16,374 | 17.27 1.02 |
| 818 | 0 | 271.73 0.00 0.00 | 0.00 | \$948 | 0 | \$16,374 | 17.27 1.02 |
| Total | | 13130.34 647.56 320.90 | 983.32 | \$71645 | 0 | \$863,062 | 12.05 1.31 |
| <hr/> | | | | | | | |
| 1700 | 0 | 203.08 0.00 0.00 | 0.00 | \$709 | 0 | \$13,803 | 19.47 0.90 |
| N | | | | | | | |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 1 BUILDING LIST

312 , 315 , 499 , 625 , 626 , 627 , 628 , 629 ,
630 , 631 , 633 , 634 , 635 , 636 , 638 , 650 ,
651 , 652 , 653 , 654 , 655 , 656 , 657 , 658 ,
659 , 660 , 730 , 731 , 732 , 733 , 734 , 735 ,
736 , 738 , 739 , 740 , 741 , 743 , 747 , 748 ,
749 , 750 , 751 , 752 , 753 , 754 , 755 , 756 ,
815 , 816 , 817 , 818 , 819 , 820 , 821 , 822 ,
823 , 824 , 825 , 827 , 828 , 829 , 830 , 831 ,
832 , 836 , 838 , 840 , 841 , 842 , 1006 , 1007 ,
1008 , 1009 , 1010 , 1011 , 1012 , 1013 , 1014 , 1015 ,
1016 , 1018 , 1025 , 1028 , 1029 , 1601 , 4100 , 4101 ,
4102 , 4103 , 4104

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #1A: Insulation, Metal Roof

CURRENT SITUATION: (Permanent Buildings)

The pre-engineered metal buildings used for barracks and latrines have minimal insulation. Systems are commercially available to add insulation to these structures without disruption of the exterior weathering membrane.

The typical buildings (#562 and 565) are used only in summer and are not air conditioned. These buildings consume no heating and cooling energy, they do have exhaust fans for summer ventilation.

Our savings calculations assume that the heating plants are recommissioned and the buildings are used year round. Use of the buildings will actually increase energy consumption but this ECO will reduce that increase.

PROPOSAL:

Re-insulate the roof by suspending a new R19 insulation system beneath the roof purlins. A system comparable to Heat Flow Shield, manufactured by Construction Plastics, has been used for savings calculations.

ECONOMICS:

The total cost, savings, Savings Investment Ratio (SIR) and simple payback are:

Heating Energy Savings Per Year: \$ 50,175
8,089 MBTU

Total Construction Cost: \$ 412,280

Simple Payback (YRS): 8.22

SIR: 1.37

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 1A

REINSULATE METAL ROOF

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|---------|--------|-------|-----------------|-----------------|----------------|---------|------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 562 | 0 | 0.00 | 91.92 | 0.00 | 0.00 | \$570 | 0 | \$4,685 | 8.22 | 1.37 |
| 562 | 78 | 0.00 | 7169.76 | 0.00 | 0.00 | \$44474 | 0 | \$365,430 | 8.22 | 1.37 |
| 565 | 0 | 0.00 | 91.92 | 0.00 | 0.00 | \$570 | 0 | \$4,685 | 8.22 | 1.37 |
| 565 | 8 | 0.00 | 735.36 | 0.00 | 0.00 | \$4561 | 0 | \$37,480 | 8.22 | 1.37 |
| Total | | 0.00 | 8088.96 | 0.00 | 0.00 | \$50175 | 0 | \$412,280 | 8.22 | 1.37 |

ECO 1A BUILDING LIST

| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 561 , | 562 , | 563 , | 564 , | 565 , | 565 , | 566 , | 567 , |
| 568 , | 569 , | 664 , | 665 , | 666 , | 667 , | 668 , | 669 , |
| 686 , | 687 , | 688 , | 689 , | 690 , | 691 , | 692 , | 693 , |
| 694 , | 701 , | 702 , | 703 , | 704 , | 705 , | 706 , | 707 , |
| 709 , | 710 , | 711 , | 712 , | 713 , | 714 , | 715 , | 716 , |
| 717 , | 718 , | 719 , | 720 , | 721 , | 722 , | 723 , | 724 , |
| 725 , | 726 , | 727 , | 728 , | 758 , | 759 , | 760 , | 761 , |
| 762 , | 763 , | 764 , | 765 , | 766 , | 790 , | 791 , | 792 , |
| 793 , | 794 , | 795 , | 796 , | 797 , | 798 , | 806 , | 807 , |
| 808 , | 809 , | 810 , | 811 , | 812 , | 813 , | 814 , | 851 , |
| 852 , | 853 , | 854 , | 855 , | 856 , | 857 , | 858 , | 859 |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #1B: Insulation, Metal Walls

CURRENT SITUATION: (Permanent Buildings)

As have the metal building roofs, the metal building walls have been installed with minimal (1 1/2") insulation.

The typical buildings (#562 and 565) are used only in summer and are not air conditioned. These buildings consume no heating and cooling energy, they do have exhaust fans for summer ventilation.

PROPOSAL:

Fill the cavity between the exterior wall panels and the interior liner panels with insulation. This may be done with either blown-in insulation thru drilled then capped holes, or batt insulation installed by removal and replacement of wall panels.

ECONOMICS:

The total cost, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|----------------------------------|-----------|
| Heating Energy Savings Per Year: | \$ 29,800 |
| 4,804 MBTU | |

| | |
|--------------------------|------------|
| Total Construction Cost: | \$ 125,928 |
|--------------------------|------------|

| | |
|-----------------------|------|
| Simple Payback (YRS): | 4.23 |
|-----------------------|------|

| | |
|------|------|
| SIR: | 3.95 |
|------|------|

FORT LEONARD WOOD
CONTRACT DACA41-85-C-0112

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 18

INSULATE METAL WALLS

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|---------|--------|-------|-----------------|-----------------|----------------|---------|------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 562 | 0 | 0.00 | 54.60 | 0.00 | 0.00 | \$339 | 0 | \$1,431 | 4.22 | 3.95 |
| 562 | 78 | 0.00 | 4258.80 | 0.00 | 0.00 | \$26417 | 0 | \$111,618 | 4.23 | 3.95 |
| 565 | 0 | 0.00 | 54.60 | 0.00 | 0.00 | \$339 | 0 | \$1,431 | 4.22 | 3.95 |
| 565 | 8 | 0.00 | 436.00 | 0.00 | 0.00 | \$2705 | 0 | \$11,448 | 4.23 | 3.95 |
| Total | | 0.00 | 4804.00 | 0.00 | 0.00 | \$29800 | 0 | \$125,928 | 4.23 | 3.95 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH)
to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 1B BUILDING LIST

| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 561 , | 562 , | 563 , | 564 , | 565 , | 565 , | 566 , | 567 , |
| 568 , | 569 , | 664 , | 665 , | 666 , | 667 , | 668 , | 669 , |
| 686 , | 687 , | 688 , | 689 , | 690 , | 691 , | 692 , | 693 , |
| 694 , | 701 , | 702 , | 703 , | 704 , | 705 , | 706 , | 707 , |
| 709 , | 710 , | 711 , | 712 , | 713 , | 714 , | 715 , | 716 , |
| 717 , | 718 , | 719 , | 720 , | 721 , | 722 , | 723 , | 724 , |
| 725 , | 726 , | 727 , | 728 , | 758 , | 759 , | 760 , | 761 , |
| 762 , | 763 , | 764 , | 765 , | 766 , | 790 , | 791 , | 792 , |
| 793 , | 794 , | 795 , | 796 , | 797 , | 798 , | 806 , | 807 , |
| 808 , | 809 , | 810 , | 811 , | 812 , | 813 , | 814 , | 851 , |
| 852 , | 853 , | 854 , | 855 , | 856 , | 857 , | 858 , | 859 |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #2: Weather Stripping and Caulking

CURRENT SITUATION:

A. Window Weather Stripping

The majority of the windows have recently been replaced and are in good condition. Those that are in poor condition are generally in areas where reduced infiltration around the casement will have minimal effect on energy consumption, ie., bay areas with large overheat doors.

B. Door Weather Stripping

Our observations revealed that most of the door weather stripping was in poor condition or non-existent.

PROPOSAL:

Replace or install new door weather stripping in areas where the stripping is in poor condition and or non-existent. It is also recommended to caulk all exterior JAMB casings.

ECONOMICS:

The total cost, savings, Savings Investment Ratio (SIR) and simple payback are:

Heating Energy Savings Per Year: \$ 8,175
1357 MBTU

Electricity Savings Per Year: \$ 825
40 MBTU

Total Savings Per Year: \$ 9,000

Total Construction Cost: \$ 40,560

Simple Payback (YRS): \$ 4.51

SIR: 1.43

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 2

WEATHER STRIP & CAULK

ECO LIFE: 8 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|----------------|---------------|--------------|---------------|-----------------|-----------------|-------------|-------------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | SAVINGS | | COST | PAYBACK | SIR |
| 1700 | 0 | 0.00 | 0.00 | 0.00 | 40.11 | \$825 | 0 | \$1,680 | 2.04 | 2.83 |
| 318 | 0 | 0.00 | 13.03 | 0.00 | 0.00 | \$81 | 0 | \$360 | 4.44 | 1.45 |
| 319 | 0 | 0.00 | 13.03 | 0.00 | 0.00 | \$81 | 0 | \$360 | 4.44 | 1.45 |
| 450 | 0 | 0.00 | 47.79 | 0.00 | 0.00 | \$296 | 0 | \$1,320 | 4.46 | 1.45 |
| 499 | 0 | 0.00 | 78.21 | 0.00 | 0.00 | \$485 | 0 | \$2,160 | 4.45 | 1.45 |
| 562 | 0 | 0.00 | 8.69 | 0.00 | 0.00 | \$54 | 0 | \$240 | 4.44 | 1.45 |
| 562 | 78 | 0.00 | 677.82 | 0.00 | 0.00 | \$4205 | 0 | \$18,720 | 4.45 | 1.45 |
| 565 | 0 | 0.00 | 13.03 | 0.00 | 0.00 | \$81 | 0 | \$360 | 4.44 | 1.45 |
| 565 | 8 | 0.00 | 104.24 | 0.00 | 0.00 | \$647 | 0 | \$2,880 | 4.45 | 1.45 |
| 2399 | 0 | 0.00 | 24.21 | 0.00 | 0.00 | \$150 | 0 | \$720 | 4.80 | 1.35 |
| 4102 | 0 | 0.00 | 20.17 | 0.00 | 0.00 | \$125 | 0 | \$600 | 4.80 | 1.35 |
| 4102 | 4 | 0.00 | 80.68 | 0.00 | 0.00 | \$500 | 0 | \$2,400 | 4.80 | 1.35 |
| 5074 | 0 | 0.00 | 27.46 | 0.00 | 0.00 | \$170 | 0 | \$840 | 4.94 | 1.31 |
| 312 | 0 | 0.00 | 33.89 | 0.00 | 0.00 | \$210 | 0 | \$1,080 | 5.14 | 1.26 |
| 1601 | 0 | 0.00 | 26.36 | 0.00 | 0.00 | \$164 | 0 | \$840 | 5.12 | 1.26 |
| 2395 | 0 | 0.00 | 0.00 | 8.07 | 0.00 | \$40 | 0 | \$240 | 6.00 | 1.16 |
| 5150 | 0 | 0.00 | 0.00 | 60.26 | 0.00 | \$295 | 0 | \$1,920 | 6.51 | 1.09 |
| 315 | 0 | 0.00 | 0.00 | 15.06 | 0.00 | \$74 | 0 | \$480 | 6.49 | 1.08 |
| 5050 | 0 | 0.00 | 0.00 | 22.59 | 0.00 | \$111 | 0 | \$720 | 6.49 | 1.08 |
| 5052 | 0 | 0.00 | 0.00 | 45.19 | 0.00 | \$221 | 0 | \$1,440 | 6.52 | 1.08 |
| 5053 | 0 | 0.00 | 0.00 | 37.66 | 0.00 | \$185 | 0 | \$1,200 | 6.49 | 1.08 |
| Total | | 0.00 | 1168.61 | 188.83 | 40.11 | \$9000 | 0 | \$40,560 | 4.51 | 1.43 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH)
to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 2 BUILDING LIST

| | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 312 , | 315 , | 318 , | 319 , | 450 , | 499 , | 561 , | 562 , |
| 563 , | 564 , | 565 , | 565 , | 566 , | 567 , | 568 , | 569 , |
| 664 , | 665 , | 666 , | 667 , | 668 , | 669 , | 686 , | 687 , |
| 688 , | 689 , | 690 , | 691 , | 692 , | 693 , | 694 , | 701 , |
| 702 , | 703 , | 704 , | 705 , | 706 , | 707 , | 709 , | 710 , |
| 711 , | 712 , | 713 , | 713 , | 714 , | 715 , | 716 , | 717 , |
| 718 , | 719 , | 720 , | 721 , | 722 , | 723 , | 724 , | 725 , |
| 726 , | 727 , | 728 , | 758 , | 759 , | 760 , | 761 , | 762 , |
| 763 , | 764 , | 765 , | 766 , | 790 , | 791 , | 792 , | 793 , |
| 794 , | 795 , | 796 , | 797 , | 798 , | 806 , | 807 , | 808 , |
| 809 , | 810 , | 811 , | 812 , | 813 , | 814 , | 851 , | 852 , |
| 853 , | 854 , | 855 , | 856 , | 857 , | 858 , | 859 , | 1601 , |
| 1700 , | 2395 , | 2399 , | 4100 , | 4101 , | 4102 , | 4103 , | 4104 , |
| 5050 , | 5052 , | 5053 , | 5074 , | 5150 | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #10: Replace Incandescent Lamps with Fluorescent

CURRENT SITUATION:

Incandescent lamps are in use in many locations throughout the fort. Particulary prevalent are recessed "can" fixtures. New twin tube fluorescent lamps with in-line ballast, reflector and lens are made to replace 75 or 150 watt flood lamps.

PROPOSAL:

Replace incandescent lamps with twin tube PL type or other appropriate fluorescent fixture.

ECONOMICS:

The total cost, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|--|------------|
| Heating Energy Savings Per Year: N/A MBTU | \$ N / A |
| Electricity Savings Per Year: 4827 MBTU | \$ 99,312 |
| Total Savings Per Year: | \$ 99,312 |
| Total Construction Cost: | \$ 308,862 |
| Simple Payback (YRS): | 3.11 |
| SIR: | 3.54 |

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 10

REPLACE INCAN. LIGHTING

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL | OTHER SAVING | PROJECT COST | SIMPLE PAYBACK | SIR |
|--------------------|-------------|-----------------------------------|--------|--------|---------|---------|-----------------|--------------|----------------|-------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | | | |
| 672 | 0 | 0.00 | 0.00 | 0.00 | 35.50 | \$730 | 0 | \$380 | 0.52 | 21.16 |
| 672 | 10 | 0.00 | 0.00 | 0.00 | 354.95 | \$7303 | 0 | \$3,800 | 0.52 | 21.16 |
| 780 | 0 | 0.00 | 0.00 | 0.00 | 35.50 | \$730 | 0 | \$380 | 0.52 | 21.16 |
| 1601 | 0 | 0.00 | 0.00 | 0.00 | 60.06 | \$1236 | 0 | \$1,140 | 0.92 | 11.94 |
| 821 | 0 | 0.00 | 0.00 | 0.00 | 58.68 | \$1207 | 0 | \$1,890 | 1.57 | 7.03 |
| 5050 | 0 | 0.00 | 0.00 | 0.00 | 2.15 | \$44 | 0 | \$71 | 1.61 | 6.85 |
| 499 | 0 | 0.00 | 0.00 | 0.00 | 16.77 | \$345 | 0 | \$641 | 1.86 | 5.93 |
| 565 | 0 | 0.00 | 0.00 | 0.00 | 26.72 | \$550 | 0 | \$1,140 | 2.07 | 5.31 |
| 565 | 8 | 0.00 | 0.00 | 0.00 | 213.72 | \$4397 | 0 | \$9,120 | 2.07 | 5.31 |
| 735 | 0 | 0.00 | 0.00 | 0.00 | 0.81 | \$17 | 0 | \$36 | 2.12 | 5.07 |
| 500 | 0 | 0.00 | 0.00 | 0.00 | 19.42 | \$400 | 0 | \$891 | 2.23 | 4.94 |
| 657 | 0 | 0.00 | 0.00 | 0.00 | 18.64 | \$384 | 0 | \$933 | 2.43 | 4.53 |
| 657 | 7 | 0.00 | 0.00 | 0.00 | 130.45 | \$2684 | 0 | \$6,528 | 2.43 | 4.53 |
| 743 | 0 | 0.00 | 0.00 | 0.00 | 7.83 | \$161 | 0 | \$401 | 2.49 | 4.42 |
| 743 | 3 | 0.00 | 0.00 | 0.00 | 23.48 | \$483 | 0 | \$1,202 | 2.49 | 4.42 |
| 312 | 0 | 0.00 | 0.00 | 0.00 | 111.23 | \$2289 | 0 | \$6,153 | 2.69 | 4.10 |
| 1010 | 0 | 0.00 | 0.00 | 0.00 | 34.11 | \$702 | 0 | \$1,961 | 2.79 | 3.94 |
| 1010 | 1 | 0.00 | 0.00 | 0.00 | 34.11 | \$702 | 0 | \$1,961 | 2.79 | 3.94 |
| 741 | 0 | 0.00 | 0.00 | 0.00 | 7.83 | \$161 | 0 | \$475 | 2.95 | 3.73 |
| 2399 | 0 | 0.00 | 0.00 | 0.00 | 0.37 | \$8 | 0 | \$23 | 2.88 | 3.68 |
| 1608 | 0 | 0.00 | 0.00 | 0.00 | 0.37 | \$8 | 0 | \$162 | 20.25 | 3.65 |
| 5053 | 0 | 0.00 | 0.00 | 0.00 | 1.49 | \$31 | 0 | \$93 | 3.00 | 3.63 |
| 734 | 0 | 0.00 | 0.00 | 0.00 | 56.64 | \$1165 | 0 | \$3,615 | 3.10 | 3.55 |
| 823 | 0 | 0.00 | 0.00 | 0.00 | 49.80 | \$1025 | 0 | \$3,271 | 3.19 | 3.45 |
| 1720 | 0 | 0.00 | 0.00 | 0.00 | 114.61 | \$2358 | 0 | \$7,656 | 3.25 | 3.39 |
| 1720 | 10 | 0.00 | 0.00 | 0.00 | 1146.06 | \$23580 | 0 | \$76,560 | 3.25 | 3.39 |
| 1724 | 0 | 0.00 | 0.00 | 0.00 | 55.72 | \$1146 | 0 | \$3,724 | 3.25 | 3.39 |
| 1724 | 14 | 0.00 | 0.00 | 0.00 | 780.04 | \$16049 | 0 | \$52,135 | 3.25 | 3.39 |
| 1766 | 0 | 0.00 | 0.00 | 0.00 | 55.72 | \$1146 | 0 | \$3,724 | 3.25 | 3.39 |
| 1769 | 0 | 0.00 | 0.00 | 0.00 | 114.61 | \$2358 | 0 | \$7,656 | 3.25 | 3.39 |
| 655 | 0 | 0.00 | 0.00 | 0.00 | 45.54 | \$937 | 0 | \$3,109 | 3.32 | 3.32 |
| 655 | 11 | 0.00 | 0.00 | 0.00 | 500.97 | \$10307 | 0 | \$34,203 | 3.32 | 3.32 |
| 450 | 0 | 0.00 | 0.00 | 0.00 | 13.42 | \$276 | 0 | \$925 | 3.35 | 3.29 |
| 822 | 0 | 0.00 | 0.00 | 0.00 | 5.96 | \$123 | 0 | \$420 | 3.41 | 3.22 |
| 1006 | 0 | 0.00 | 0.00 | 0.00 | 28.47 | \$586 | 0 | \$2,019 | 3.45 | 3.19 |
| 185 | 0 | 0.00 | 0.00 | 0.00 | 3.41 | \$70 | 0 | \$278 | 3.97 | 2.78 |
| 1008 | 0 | 0.00 | 0.00 | 0.00 | 5.03 | \$103 | 0 | \$518 | 5.03 | 2.20 |
| 628 | 0 | 0.00 | 0.00 | 0.00 | 24.91 | \$513 | 0 | \$2,637 | 5.14 | 2.14 |
| 628 | 25 | 0.00 | 0.00 | 0.00 | 622.80 | \$12814 | 0 | \$65,920 | 5.14 | 2.14 |
| 740 | 0 | 0.00 | 0.00 | 0.00 | 0.74 | \$15 | 0 | \$93 | 6.20 | 1.81 |
| 740 | 11 | 0.00 | 0.00 | 0.00 | 8.19 | \$169 | 0 | \$1,018 | 6.02 | 1.81 |
| Total | | 0.00 | 0.00 | 0.00 | 4826.83 | \$99312 | 0 | \$308,862 | 3.11 | 3.54 |

Note: Factor Electric MBTU/Yr savings from calculation work sheets by (3,413 site + 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 10 BUILDING LIST

| | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 185 , | 312 , | 450 , | 499 , | 500 , | 565 , | 625 , | 626 , |
| 627 , | 628 , | 629 , | 630 , | 631 , | 633 , | 634 , | 635 , |
| 638 , | 650 , | 651 , | 652 , | 653 , | 654 , | 655 , | 656 , |
| 657 , | 658 , | 659 , | 660 , | 672 , | 673 , | 680 , | 681 , |
| 688 , | 703 , | 713 , | 722 , | 730 , | 731 , | 732 , | 733 , |
| 734 , | 735 , | 736 , | 738 , | 739 , | 740 , | 741 , | 743 , |
| 748 , | 749 , | 750 , | 751 , | 752 , | 753 , | 754 , | 755 , |
| 756 , | 760 , | 772 , | 773 , | 780 , | 781 , | 792 , | 811 , |
| 815 , | 816 , | 817 , | 819 , | 820 , | 821 , | 822 , | 823 , |
| 824 , | 825 , | 827 , | 828 , | 829 , | 830 , | 831 , | 832 , |
| 836 , | 838 , | 840 , | 841 , | 842 , | 853 , | 990 , | 991 , |
| 998 , | 999 , | 1006 , | 1007 , | 1008 , | 1009 , | 1010 , | 1011 , |
| 1018 , | 1025 , | 1601 , | 1608 , | 1720 , | 1722 , | 1723 , | 1724 , |
| 1725 , | 1726 , | 1728 , | 1729 , | 1730 , | 1731 , | 1732 , | 1733 , |
| 1734 , | 1735 , | 1761 , | 1762 , | 1763 , | 1764 , | 1765 , | 1766 , |
| 1767 , | 1768 , | 1769 , | 1771 , | 1773 , | 1774 , | 1775 , | 1776 , |
| 2399 , | 5050 , | 5053 | | | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #11 x : Use more efficient exit lighting

CURRENT SITUATION:

Most exit signs are illuminated by incandescent lamps.

Replacement of existing incandescent exit fixture with self illuminating tritium powered signs will eliminate the use of purchased energy for exit sign, but at great initial cost.

Conversion of the existing signs to fluorescent lamps will save 75% as much energy at 11% of the cost.

PROPOSAL:

Relamp "Exit" signs that have incandescent illumination with fluorescent twin tube lamps and ballast.

ECONOMICS:

The "per fixture" cost, savings, Savings Investment Ratio (SIR) and simple payback are:

Electricity Savings Per Year: \$ 68,174
3313 MBTU

Maintenance Savings Per Year: \$ 1,154

Total Savings Per Year: \$ 69,324

Total Construction Cost: \$ 20,768

Simple Payback (YRS): 0.30

SIR: 36.79

Cost estimate by Overland Park, Kansas
Lighting Contractor, Fuel Economy Labs

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 11X

EXIT LIGHT REPLACEMENT

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | FUEL | OTHER | PROJECT SIMPLE |
|--------------------|-------------|-----------------------------------|---------|----------------|------------------------|
| | | #6 OIL #2 OIL LP GAS | ELECT | SAVINGS | COST PAYBACK SIR |
| 450 | 0 | 0.00 0.00 0.00 | 19.86 | \$409 5 | \$91 0.22 50.08 |
| 312 | 0 | 0.00 0.00 0.00 | 28.68 | \$590 9 | \$159 0.27 41.50 |
| 628 | 0 | 0.00 0.00 0.00 | 48.44 | \$997 15 | \$272 0.27 40.99 |
| 628 | 25 | 0.00 0.00 0.00 | 1211.00 | \$24916 375 | \$6,800 0.27 40.99 |
| 499 | 0 | 0.00 0.00 0.00 | 7.90 | \$163 3 | \$45 0.27 40.42 |
| 743 | 0 | 0.00 0.00 0.00 | 7.90 | \$163 3 | \$45 0.27 40.42 |
| 743 | 3 | 0.00 0.00 0.00 | 23.70 | \$488 8 | \$135 0.27 40.42 |
| 315 | 0 | 0.00 0.00 0.00 | 75.09 | \$1545 24 | \$431 0.27 40.11 |
| 821 | 0 | 0.00 0.00 0.00 | 27.67 | \$569 9 | \$159 0.28 40.07 |
| 747 | 0 | 0.00 0.00 0.00 | 71.14 | \$1464 23 | \$409 0.28 40.05 |
| 818 | 0 | 0.00 0.00 0.00 | 71.14 | \$1464 23 | \$409 0.28 40.05 |
| 1014 | 0 | 0.00 0.00 0.00 | 71.14 | \$1464 23 | \$409 0.28 40.05 |
| 1014 | 5 | 0.00 0.00 0.00 | 355.70 | \$7319 113 | \$2,045 0.28 40.05 |
| 1016 | 0 | 0.00 0.00 0.00 | 71.14 | \$1464 23 | \$409 0.28 40.05 |
| 636 | 0 | 0.00 0.00 0.00 | 15.81 | \$325 5 | \$91 0.28 40.00 |
| 740 | 0 | 0.00 0.00 0.00 | 15.81 | \$325 5 | \$91 0.28 40.00 |
| 740 | 11 | 0.00 0.00 0.00 | 173.91 | \$3578 55 | \$1,001 0.28 40.00 |
| 741 | 0 | 0.00 0.00 0.00 | 15.81 | \$325 5 | \$91 0.28 40.00 |
| 822 | 0 | 0.00 0.00 0.00 | 15.81 | \$325 5 | \$91 0.28 40.00 |
| 1008 | 0 | 0.00 0.00 0.00 | 15.81 | \$325 5 | \$91 0.28 40.00 |
| 185 | 0 | 0.00 0.00 0.00 | 5.88 | \$121 3 | \$45 0.36 30.75 |
| 1705 | 0 | 0.00 0.00 0.00 | 8.82 | \$181 4 | \$68 0.37 30.03 |
| 5231 | 0 | 0.00 0.00 0.00 | 8.82 | \$181 4 | \$68 0.37 30.03 |
| 5231 | 16 | 0.00 0.00 0.00 | 141.12 | \$2904 64 | \$1,088 0.37 30.03 |
| 1703 | 0 | 0.00 0.00 0.00 | 35.27 | \$726 15 | \$272 0.37 30.02 |
| 1703 | 1 | 0.00 0.00 0.00 | 35.27 | \$726 15 | \$272 0.37 30.02 |
| 1750 | 0 | 0.00 0.00 0.00 | 35.27 | \$726 15 | \$272 0.37 30.02 |
| 1750 | 1 | 0.00 0.00 0.00 | 35.27 | \$726 15 | \$272 0.37 30.02 |
| 5052 | 0 | 0.00 0.00 0.00 | 35.27 | \$726 15 | \$272 0.37 30.02 |
| 1608 | 0 | 0.00 0.00 0.00 | 17.63 | \$363 8 | \$136 0.37 30.01 |
| 1700 | 0 | 0.00 0.00 0.00 | 17.63 | \$363 8 | \$136 0.37 30.01 |
| 1701 | 0 | 0.00 0.00 0.00 | 29.39 | \$605 13 | \$227 0.37 29.97 |
| 1701 | 3 | 0.00 0.00 0.00 | 88.17 | \$1814 38 | \$681 0.37 29.97 |
| 5053 | 0 | 0.00 0.00 0.00 | 29.39 | \$605 13 | \$227 0.37 29.97 |

Note: Electric MBTU/Yr Savings from calculation work sheets have been calculated with
3,413 Site BTU/KWH.

ENERGY SAVING OPPORTUNITY STUDY

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|-------------|-------------|----------------|-----------------|-----------------|-----------------|-------------|--------------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 657 | 0 | 0.00 | 0.00 | 0.00 | 20.57 | \$423 | 9 | \$159 | 0.37 | 29.95 |
| 657 | 7 | 0.00 | 0.00 | 0.00 | 143.99 | \$2963 | 61 | \$1,113 | 0.37 | 29.95 |
| 735 | 0 | 0.00 | 0.00 | 0.00 | 20.57 | \$423 | 9 | \$159 | 0.37 | 29.95 |
| 5050 | 0 | 0.00 | 0.00 | 0.00 | 20.57 | \$423 | 9 | \$159 | 0.37 | 29.95 |
| 318 | 0 | 0.00 | 0.00 | 0.00 | 11.76 | \$242 | 5 | \$91 | 0.37 | 29.92 |
| 319 | 0 | 0.00 | 0.00 | 0.00 | 11.76 | \$242 | 5 | \$91 | 0.37 | 29.92 |
| 2240 | 0 | 0.00 | 0.00 | 0.00 | 11.76 | \$242 | 5 | \$91 | 0.37 | 29.92 |
| 5074 | 0 | 0.00 | 0.00 | 0.00 | 44.08 | \$907 | 19 | \$341 | 0.37 | 29.92 |
| 4102 | 0 | 0.00 | 0.00 | 0.00 | 14.69 | \$302 | 6 | \$114 | 0.37 | 29.83 |
| 4102 | 4 | 0.00 | 0.00 | 0.00 | 58.76 | \$1209 | 24 | \$456 | 0.37 | 29.83 |
| 4113 | 0 | 0.00 | 0.00 | 0.00 | 14.69 | \$302 | 6 | \$114 | 0.37 | 29.83 |
| 4113 | 5 | 0.00 | 0.00 | 0.00 | 73.45 | \$1511 | 30 | \$570 | 0.37 | 29.83 |
| Total | | 0.00 | 0.00 | 0.00 | 3313.31 | \$68174 | 1154 | \$20,768 | 0.30 | 36.79 |

Note: Electric MBTU/Yr Savings from calculation work sheets have been calculated with
3,413 Site BTU/KWH.

ECO 11X BUILDING LIST

185 , 312 , 315 , 318 , 319 , 450 , 499 , 625 ,
627 , 628 , 629 , 630 , 631 , 634 , 635 , 636 ,
638 , 650 , 651 , 652 , 653 , 654 , 657 , 658 ,
659 , 660 , 730 , 731 , 732 , 735 , 736 , 738 ,
739 , 740 , 741 , 743 , 747 , 748 , 749 , 750 ,
753 , 754 , 755 , 756 , 815 , 816 , 817 , 818 ,
819 , 820 , 821 , 822 , 825 , 827 , 828 , 829 ,
830 , 831 , 832 , 836 , 838 , 842 , 1008 , 1009 ,
1012 , 1013 , 1014 , 1015 , 1016 , 1018 , 1028 , 1029 ,
1608 , 1700 , 1701 , 1702 , 1703 , 1704 , 1705 , 1706 ,
1707 , 1740 , 1750 , 2240 , 4100 , 4101 , 4102 , 4103 ,
4104 , 4110 , 4111 , 4112 , 4113 , 4114 , 4115 , 5050 ,
5052 , 5053 , 5074 , 5161 , 5169 , 5231 , 5301 , 5334 ,
5346 , 5350 , 5361 , 5374 , 5391 , 5500 , 5511 , 5531 ,
5592 , 5702 , 5732 , 5743

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #12: Replace motors with high efficiency motors

CURRENT SITUATION:

This project should be implemented as existing motors breakdown. As shown in the ECO calculation procedure section, the incremental cost to purchase high efficiency motors when motors are replaced, is a good investment.

Several large standard efficiency motors are in service at pumping stations. These pump motors have been replaced by diesel pumps at high electrical demand periods to reduce the peak demand. When average kilowatt-hour costs are used, replacement of these motors can be economically justified. One motor in the river water intake structure, the water supply plant and the sewerage treatment control center justify immediate replacement. Other motors should be replaced by high efficiency rather than standard efficiency motors as required.

PROPOSAL:

Replace four (4) motors in building #185, one (1) motor in building #1601 and one (1) motor in building #10250.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|---|-----------|
| Electricity Savings Per Year: 375 MBTU | \$ 7,717 |
| Total Savings Per Year: | \$ 7,717 |
| Total Construction Cost: | \$ 27,351 |
| Simple Payback (YRS): | 3.54 |
| SIR: | 3.11 |

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 12

HIGH EFFICIENCY MOTORS

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------|--------|--------|-----------------|-----------------|----------------|---------|------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 10250 | 0 | 0.00 | 0.00 | 0.00 | 254.58 | \$5238 | 0 | \$16,359 | 3.12 | 3.53 |
| 1601 | 0 | 0.00 | 0.00 | 0.00 | 109.18 | \$2246 | 0 | \$8,870 | 3.95 | 2.79 |
| 185 | 0 | 0.00 | 0.00 | 0.00 | 11.31 | \$233 | 0 | \$2,122 | 9.11 | 1.21 |
| Total | | 0.00 | 0.00 | 0.00 | 375.07 | \$7717 | 0 | \$27,351 | 3.54 | 3.11 |

Note: Electric MBTU/Yr Savings from calculation work sheets have been calculated with
3,413 Site BTU/KWH.

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #14: Install infrared radiant heaters

CURRENT SITUATION:

High ceiling areas are prone to heat stratification and generally, large amounts of infiltration from overhead doors. To reduce both of these problems, radiant heaters may be used to heat the objects in the space directly without using the air as a transfer medium.

There is not a standard calculation procedure to determine savings from the conversion to radiant heat. An ASHRAE study mentioned in the 1983 ASHRAE equipment handbook claims that savings may be up to 50%. We have claimed 35% savings, in agreement with the Co-Ray-Vac engineering manual.

Fort Leonard Wood personnel now claim to setback all buildings when they are unoccupied, so heating degree hours have been adjusted to consider the stated operating hours and days per week.

PROPOSAL:

Install radiant heaters in large open areas to reduce inefficiencies associated with convective heating systems.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|---|-----------|
| Heating Energy Savings Per Year: 1749 MBTU | \$ 13,392 |
| Electricity Savings Per Year: 97 MBTU | \$ 1,985 |
| Total Savings Per Year | \$ 15,377 |
| Total Construction Cost: | \$ 89,630 |
| Simple Payback (YRS): | 5.83 |
| SIR: | 2.46 |

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 14

INFRARED HEATERS

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|----------------|-----------------|--------------|-----------------|-----------------|-----------------|-------------|-------------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 5074 | 0 | 0.00 | 466.00 | -303.00 | 13.83 | \$1690 | 0 | \$6,003 | 3.55 | 3.78 |
| 672 | 0 | 0.00 | 257.00 | -167.00 | 4.41 | \$867 | 0 | \$4,168 | 4.81 | 2.83 |
| 672 | 10 | 0.00 | 2570.00 | -1670.00 | 44.13 | \$8667 | 0 | \$41,680 | 4.81 | 2.83 |
| 780 | 0 | 0.00 | 240.00 | -156.00 | 4.12 | \$809 | 0 | \$4,168 | 5.15 | 2.64 |
| 5122 | 0 | 0.00 | 83.00 | -54.00 | 5.59 | \$365 | 0 | \$2,332 | 6.39 | 2.03 |
| 5122 | 1 | 0.00 | 83.00 | -54.00 | 5.59 | \$365 | 0 | \$2,332 | 6.39 | 2.03 |
| 5150 | 0 | 0.00 | 0.00 | 190.00 | 7.65 | \$1088 | 0 | \$10,767 | 9.90 | 1.83 |
| 5052 | 0 | 0.00 | 0.00 | 106.00 | 3.24 | \$586 | 0 | \$6,916 | 11.80 | 1.56 |
| 5053 | 0 | 0.00 | 0.00 | 121.00 | 5.59 | \$708 | 0 | \$8,200 | 11.58 | 1.55 |
| 2395 | 0 | 0.00 | 0.00 | 37.00 | 2.35 | \$230 | 0 | \$3,064 | 13.32 | 1.32 |
| Total | | 0.00 | 3699.00 | -1950.00 | 96.50 | \$15375 | 0 | \$89,630 | 5.83 | 2.46 |
| 2250 | 0 | 0.00 | 46.00 | -30.00 | 1.18 | \$163 | 0 | \$2,332 | 14.31 | 0.94 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site + 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 14 BUILDING LIST

672 , 673 , 680 , 681 , 772 , 773 , 780 , 781 ,
990 , 991 , 998 , 999 , 2395 , 5052 , 5053 , 5074 ,
5122 , 5130 , 5150

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #15: Dry Bulb Economizer

CURRENT SITUATION:

Buildings that have existing air handling units with outside air and relief dampers may be modified to include economizer cycles at a reasonable cost.

PROPOSAL:

Utilize the proper equipment to install a drybulb economizer cycle on the air handling units that posses motor actuated return and outside air damper. Outside air temperature sensors would be installed as required along with the central control panel.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|--|-----------|
| Electricity Savings Per Year: 2839 MBTU | \$ 58,405 |
| Total Construction Cost: | \$ 21,780 |
| Simple Payback (YRS): | 0.37 |
| SIR: | 22.95 |

FORT LEONARD WOOD
CONTRACT DACA41-85-C-0112

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 15

DRY BULB ECONOMIZER

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT COST | SIMPLE PAYBACK | SIR |
|--------------------|-------------|-----------------------------------|-------------|-------------|----------------|-----------------|-----------------|-----------------|-------------------|--------------|
| 628 | 0 | 0.00 | 0.00 | 0.00 | 90.33 | \$1859 | 0 | \$376 | 0.20 | 42.31 |
| 628 | 25 | 0.00 | 0.00 | 0.00 | 2258.17 | \$46462 | 0 | \$9,400 | 0.20 | 42.31 |
| 821 | 0 | 0.00 | 0.00 | 0.00 | 42.37 | \$872 | 0 | \$376 | 0.43 | 19.85 |
| 1750 | 0 | 0.00 | 0.00 | 0.00 | 33.54 | \$690 | 0 | \$376 | 0.54 | 15.71 |
| 1750 | 1 | 0.00 | 0.00 | 0.00 | 33.54 | \$690 | 0 | \$376 | 0.54 | 15.71 |
| 657 | 0 | 0.00 | 0.00 | 0.00 | 27.07 | \$557 | 0 | \$505 | 0.91 | 9.44 |
| 657 | 7 | 0.00 | 0.00 | 0.00 | 189.48 | \$3899 | 0 | \$3,535 | 0.91 | 9.44 |
| 1705 | 0 | 0.00 | 0.00 | 0.00 | 9.42 | \$194 | 0 | \$188 | 0.97 | 8.82 |
| 500 | 0 | 0.00 | 0.00 | 0.00 | 9.12 | \$188 | 0 | \$188 | 1.00 | 8.54 |
| 735 | 0 | 0.00 | 0.00 | 0.00 | 17.95 | \$369 | 0 | \$505 | 1.37 | 6.26 |
| 1608 | 0 | 0.00 | 0.00 | 0.00 | 8.24 | \$170 | 0 | \$252 | 1.48 | 5.76 |
| 822 | 0 | 0.00 | 0.00 | 0.00 | 5.59 | \$115 | 0 | \$188 | 1.63 | 5.24 |
| 1010 | 0 | 0.00 | 0.00 | 0.00 | 10.89 | \$224 | 0 | \$376 | 1.68 | 5.10 |
| 1010 | 1 | 0.00 | 0.00 | 0.00 | 10.89 | \$224 | 0 | \$376 | 1.68 | 5.10 |
| 740 | 0 | 0.00 | 0.00 | 0.00 | 4.71 | \$97 | 0 | \$188 | 1.94 | 4.41 |
| 740 | 11 | 0.00 | 0.00 | 0.00 | 51.78 | \$1065 | 0 | \$2,068 | 1.94 | 4.41 |
| 1703 | 0 | 0.00 | 0.00 | 0.00 | 4.41 | \$91 | 0 | \$188 | 2.07 | 4.13 |
| 1703 | 1 | 0.00 | 0.00 | 0.00 | 4.41 | \$91 | 0 | \$188 | 2.07 | 4.13 |
| 5074 | 0 | 0.00 | 0.00 | 0.00 | 8.53 | \$176 | 0 | \$563 | 3.20 | 2.67 |
| 499 | 0 | 0.00 | 0.00 | 0.00 | 2.65 | \$55 | 0 | \$188 | 3.42 | 2.48 |
| 743 | 0 | 0.00 | 0.00 | 0.00 | 2.35 | \$48 | 0 | \$188 | 3.92 | 2.21 |
| 743 | 3 | 0.00 | 0.00 | 0.00 | 7.06 | \$145 | 0 | \$564 | 3.89 | 2.21 |
| 1008 | 0 | 0.00 | 0.00 | 0.00 | 2.35 | \$48 | 0 | \$188 | 3.92 | 2.21 |
| 2399 | 0 | 0.00 | 0.00 | 0.00 | 1.77 | \$36 | 0 | \$188 | 5.22 | 1.65 |
| 312 | 0 | 0.00 | 0.00 | 0.00 | 2.06 | \$42 | 0 | \$252 | 6.00 | 1.44 |
| Total | | 0.00 | 0.00 | 0.00 | 2838.68 | \$58407 | 0 | \$21,780 | 0.37 | 22.95 |
| <hr/> | | | | | | | | | | |
| 315 | 0 | 0.00 | 0.00 | 0.00 | 1.18 | \$24 | 0 | \$252 | 10.50 | 0.82 |
| 185 | 0 | 0.00 | 0.00 | 0.00 | 0.29 | \$6 | 0 | \$252 | 42.00 | 0.21 |
| Total | | 0.00 | 0.00 | 0.00 | 1.47 | \$30 | 0 | \$504 | | |
| <hr/> | | | | | | | | | | |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site + 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 15 BUILDING LIST

312 , 499 , 500 , 625 , 627 , 628 , 629 , 630 ,
631 , 634 , 635 , 638 , 650 , 651 , 652 , 653 ,
654 , 657 , 658 , 659 , 660 , 730 , 731 , 732 ,
735 , 736 , 738 , 739 , 740 , 743 , 748 , 749 ,
750 , 753 , 754 , 755 , 756 , 815 , 816 , 817 ,
819 , 820 , 821 , 822 , 825 , 827 , 828 , 829 ,
830 , 831 , 832 , 836 , 838 , 842 , 1008 , 1009 ,
1010 , 1011 , 1018 , 1608 , 1703 , 1704 , 1705 , 1740 ,
1750 , 2399 , 5074

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #16: Domestic Hot Water Circulation

CURRENT SITUATION:

We have considered the pump savings to be realized by shutting the DHW circulation pump "OFF" when the building is unoccupied. Additional savings from reduced piping heat loss was also considered.

Many buildings no longer have domestic hot water. This ECO would not apply to them.

PROPOSAL:

Use timeclock operation schedules to turn off domestic hot water circulation pumps during unoccupied periods.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

Heating Energy Savings Per Year: \$ 3,577
962 MBTU

Electricity Savings Per Year: \$ 1,278
62

Total Savings Per Year: \$ 4,855

Total Construction Cost: \$ 11,396

Simple Payback (YRS): 2.35

SIR: 6.82

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 16

CONTROL HW CIRC PUMP

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL ELECT | OTHER SAVINGS | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------------|---------------|--------------|---------------|------------------|-----------------|-------------|-------------|
| | | #6 OIL | #2 OIL | LP GAS | COST | | | PAYBACK | SIR | |
| 1608 | 0 | 0.00 | 0.00 | 89.86 | 1.06 | \$462 | 0 | \$154 | 0.33 | 56.72 |
| 500 | 0 | 63.19 | 0.00 | 0.00 | 1.06 | \$242 | 0 | \$154 | 0.64 | 26.78 |
| 1703 | 0 | 0.00 | 0.00 | 0.00 | 9.91 | \$204 | 0 | \$154 | 0.75 | 14.58 |
| 1703 | 1 | 0.00 | 0.00 | 0.00 | 9.91 | \$204 | 0 | \$154 | 0.75 | 14.58 |
| 318 | 0 | 0.00 | 14.08 | 0.00 | 0.43 | \$96 | 0 | \$154 | 1.60 | 10.09 |
| 319 | 0 | 0.00 | 14.08 | 0.00 | 0.43 | \$96 | 0 | \$154 | 1.60 | 10.09 |
| 315 | 0 | 0.00 | 0.00 | 12.48 | 1.06 | \$83 | 0 | \$154 | 1.86 | 9.22 |
| 1750 | 0 | 18.93 | 0.00 | 0.00 | 0.45 | \$75 | 0 | \$154 | 2.05 | 8.22 |
| 1750 | 1 | 18.93 | 0.00 | 0.00 | 0.45 | \$75 | 0 | \$154 | 2.05 | 8.22 |
| 1720 | 0 | 16.25 | 0.00 | 0.00 | 0.43 | \$66 | 0 | \$154 | 2.33 | 7.12 |
| 1720 | 10 | 162.50 | 0.00 | 0.00 | 4.30 | \$656 | 0 | \$1,540 | 2.35 | 7.12 |
| 1769 | 0 | 15.60 | 0.00 | 0.00 | 0.43 | \$63 | 0 | \$154 | 2.44 | 6.86 |
| 1014 | 0 | 9.10 | 0.00 | 0.00 | 1.77 | \$68 | 0 | \$154 | 2.26 | 6.24 |
| 1014 | 5 | 45.50 | 0.00 | 0.00 | 8.85 | \$341 | 0 | \$770 | 2.26 | 6.24 |
| 1016 | 0 | 9.10 | 0.00 | 0.00 | 1.77 | \$68 | 0 | \$154 | 2.26 | 6.24 |
| 628 | 0 | 11.27 | 0.00 | 0.00 | 0.43 | \$48 | 0 | \$154 | 3.21 | 5.13 |
| 628 | 25 | 281.75 | 0.00 | 0.00 | 10.75 | \$1204 | 0 | \$3,850 | 3.20 | 5.13 |
| 747 | 0 | 9.53 | 0.00 | 0.00 | 0.43 | \$42 | 0 | \$154 | 3.67 | 4.44 |
| 818 | 0 | 9.53 | 0.00 | 0.00 | 0.43 | \$42 | 0 | \$154 | 3.67 | 4.44 |
| 1724 | 0 | 9.03 | 0.00 | 0.00 | 0.43 | \$40 | 0 | \$154 | 3.85 | 4.24 |
| 1724 | 14 | 126.42 | 0.00 | 0.00 | 6.02 | \$565 | 0 | \$2,156 | 3.82 | 4.24 |
| 1766 | 0 | 8.67 | 0.00 | 0.00 | 0.43 | \$39 | 0 | \$154 | 3.95 | 4.09 |
| 1010 | 0 | 7.89 | 0.00 | 0.00 | 0.45 | \$37 | 0 | \$154 | 4.16 | 3.81 |
| 1010 | 1 | 7.89 | 0.00 | 0.00 | 0.45 | \$37 | 0 | \$154 | 4.16 | 3.81 |
| Total | | 831.08 | 28.16 | 102.34 | 62.13 | \$4853 | 0 | \$11,396 | 2.35 | 6.82 |

Note: Electric MBTU/Yr Savings from calculation work sheets have been calculated with
3,413 Site BTU/KWH.

ECO 16 BUILDING LIST

315 , 318 , 319 , 500 , 627 , 628 , 629 , 634 ,
635 , 651 , 652 , 654 , 659 , 660 , 730 , 731 ,
736 , 738 , 747 , 748 , 755 , 756 , 815 , 816 ,
817 , 818 , 819 , 827 , 828 , 829 , 830 , 831 ,
1010 , 1011 , 1012 , 1013 , 1014 , 1015 , 1016 , 1028 ,
1029 , 1608 , 1703 , 1704 , 1720 , 1722 , 1723 , 1724 ,
1725 , 1726 , 1728 , 1729 , 1730 , 1731 , 1732 , 1733 ,
1734 , 1735 , 1740 , 1750 , 1761 , 1762 , 1763 , 1764 ,
1765 , 1766 , 1767 , 1768 , 1769 , 1771 , 1773 , 1774 ,
1775 , 1776

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #18: Decentralize Domestic Hot Water Heaters

CURRENT SITUATION:

This potential project has two sub-opportunities

1. Install point of use heaters in lieu of one heater per building.
This allows the elimination of DHW circulation pumps and eliminates standby and line losses.
2. Remove DHW loads from the central plants or space heating boilers, allowing the larger boilers to be shut down for the non-heating seasons.

An ideal example of the first opportunity is Building #318. Fifty occupants reside in the facility which has twelve (12) pars of bathrooms and one laundry. The circulation losses calculated in ECO # 16, (14.08 MBH) total \$96.19 per year at 40 hours per week, or \$404.00 per year at 168 hours per week. The average daily hot water demand for a men's dormitory is 13.1 gallon/occupant according to ASHRAE Systems Handbook, 37.13, Table 6.

$$50 \text{ occupants} \times 13.1 \text{ gal/occ. day} \times 365 \text{ days} \times 8.34 \text{ BTU/gal degree} \times 80 \text{ degree} = 159.5 \text{ MBTU/Yr}$$

It would only be practical to install electric point of use water heaters. Fuel lines and flues would have to be installed for gas field units.

At the current electric rate of \$20.575 per MBTU, 159.5 MBTU would cost \$3,282 per year.

At a 65% existing water heater efficiency and a # 2 oil cost of \$6.203 per MBTU, 159.5 MBTU would cost \$1,522 per year. \$1,522 plus the \$404 line losses total \$1,926, \$1,356 less than the point of use heater fuel cost.

Regardless of construction cost, a system that is more costly to operate cannot be economically justified.

#2 oil is the most expensive fuel other than electricity, so point of use heaters may be discounted entirely.

Building #318 is also a candidate for single domestic water heater. The local boiler in this building is used for space heat and domestic water heating. The boiler has a high fire rate of 6.3 gallons per hour.

FORT LEONARD WOOD
CONTRACT DACA41-85-C-0112

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 18

DEDICATED WATER HEATER

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | | |
|--------------------|-------------|-----------------------------------|--------|--------|-------|-----------------|-----------------|----------------|---------|------|----|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR | |
| 312 | 0 | 0.00 | 200.21 | 0.00 | 0.00 | \$1242 | 0 | \$3,866 | 3.11 | 5.36 | *R |
| 318 | 0 | 0.00 | 108.87 | 0.00 | 0.00 | \$675 | 0 | \$4,543 | 6.73 | 2.48 | |
| 319 | 0 | 0.00 | 108.87 | 0.00 | 0.00 | \$675 | 0 | \$4,543 | 6.73 | 2.48 | |
| Total | | 0.00 | 417.95 | 0.00 | 0.00 | \$2592 | 0 | \$12,952 | 5.00 | 3.34 | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #21: Reduce HVAC Air Flow

CURRENT SITUATION:

Building air flow was measured and compared to the design requirements. Several buildings were found to have an excess amount of supply air, thereby wasting fan energy.

PROPOSAL:

Reduce the air flow in the air conditioning systems to more closely match the load on the system.

Also the system in Building 1705 should be rebalanced.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|-------------------------------|------------|
| Electricity Savings Per Year: | \$ 182,095 |
| 8850 MBTU | |

| | |
|--------------------------|-----------|
| Total Construction Cost: | \$ 29,927 |
|--------------------------|-----------|

| | |
|-----------------------|------|
| Simple Payback (YRS): | 0.16 |
|-----------------------|------|

| | |
|------|-------|
| SIR: | 52.08 |
|------|-------|

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 21

REDUCE AIR FLOW

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------|--------|---------|-----------------|-----------------|----------------|---------|-------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 628 | 0 | 0.00 | 0.00 | 0.00 | 309.19 | \$6362 | 0 | \$829 | 0.13 | 65.69 |
| 628 | 25 | 0.00 | 0.00 | 0.00 | 7729.78 | \$159040 | 0 | \$20,725 | 0.13 | 65.69 |
| 821 | 0 | 0.00 | 0.00 | 0.00 | 120.64 | \$2482 | 0 | \$561 | 0.23 | 37.87 |
| 1750 | 0 | 0.00 | 0.00 | 0.00 | 121.25 | \$2495 | 0 | \$689 | 0.28 | 30.99 |
| 1750 | 1 | 0.00 | 0.00 | 0.00 | 121.25 | \$2495 | 0 | \$689 | 0.28 | 30.99 |
| 1705 | 0 | 0.00 | 0.00 | 0.00 | 33.45 | \$688 | 0 | \$354 | 0.51 | 16.64 |
| 657 | 0 | 0.00 | 0.00 | 0.00 | 49.89 | \$1026 | 0 | \$689 | 0.67 | 12.75 |
| 657 | 7 | 0.00 | 0.00 | 0.00 | 349.24 | \$7186 | 0 | \$4,823 | 0.67 | 12.75 |
| 2399 | 0 | 0.00 | 0.00 | 0.00 | 11.34 | \$233 | 0 | \$214 | 0.92 | 9.33 |
| 1608 | 0 | 0.00 | 0.00 | 0.00 | 4.44 | \$91 | 0 | \$354 | 3.89 | 2.21 |
| Total | | 0.00 | 0.00 | 0.00 | 8850.47 | \$182098 | 0 | \$29,927 | 0.16 | 52.08 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 21 BUILDING LIST

627 , 628 , 629 , 630 , 634 , 635 , 651 , 652 ,
653 , 654 , 657 , 659 , 660 , 730 , 731 , 736 ,
738 , 739 , 748 , 749 , 754 , 755 , 756 , 815 ,
816 , 817 , 819 , 820 , 821 , 827 , 828 , 829 ,
830 , 831 , 836 , 1608 , 1705 , 1740 , 1750 , 2399

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #23: Time Clocks

CURRENT SITUATION:

Timeclocks may provide the stop/start, and a night thermostat, the set-back function of an EMCS where monitoring, program security and program flexibility are not required.

PROPOSAL:

Provide stop/start in selected buildings not proposed to be included in the EMCS loop. (Building 185, 672, 780 & 5150)

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|---|-----------|
| Heating Energy Savings Per Year: 1894 MBTU | \$ 11,332 |
| Electricity Savings Per Year: 173 MBTU | \$ 3,566 |
| Total Savings Per Year: | \$ 14,898 |
| Total Construction Cost: | \$ 25,332 |
| Simple Payback (YRS): | 1.70 |
| SIR: | 6.30 |

FORT LEONARD WOOD
CONTRACT DACA41-85-C-0112

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 23

INSTALL TIME CLOCKS

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|---------|--------|--------|-----------------|-----------------|----------------|---------|-------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 5150 | 0 | 0.00 | 0.00 | 318.62 | 21.08 | \$1995 | 0 | \$1,846 | 0.93 | 12.77 |
| 185 | 0 | 0.00 | 46.82 | 0.00 | 8.33 | \$462 | 0 | \$626 | 1.35 | 7.56 |
| 780 | 0 | 0.00 | 153.61 | 0.00 | 14.46 | \$1250 | 0 | \$1,905 | 1.52 | 6.96 |
| 672 | 0 | 0.00 | 124.97 | 0.00 | 11.77 | \$1017 | 0 | \$1,905 | 1.87 | 5.66 |
| 672 | 10 | 0.00 | 1249.70 | 0.00 | 117.66 | \$10173 | 0 | \$19,050 | 1.87 | 5.66 |
| Total | | 0.00 | 1575.10 | 318.62 | 173.30 | \$14897 | 0 | \$25,332 | 1.70 | 6.30 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site + 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 23 BUILDING LIST

185 , 672 , 673 , 680 , 681 , 772 , 773 , 780 ,
781 , 990 , 991 , 998 , 999 , 5150

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #31: Dishwasher Heat Recovery

CURRENT SITUATION:

Effluent from the dishwashers at a temperature of about 130 degrees is drained directly to the sewer. Heat may be recovered from the drain water to preheat domestic hot water make-up water.

Typical mess-hall dishwashers are manufactured by Blakeslee and use from 288 to 420 gallons per hour.

Dishwasher drain flow and make-up flows are not equal, so the dishwasher must drain into a holding tank to be continuously pumped through a heat exchanger. A float in the storage tank will turn the pump on when there is sufficient water for continuous pumping. A screen filter in the tank will need to be cleaned daily to remove broken glass and garage that would otherwise clog the heat exchanger. Each meal's final rinse cycle will drain without a make-up requirement. This hot rinse should melt and remove grease that may have hardened in the heat exchanger.

PROPOSAL:

Install a dishwasher drainage tank with a removable top, screen filter discharge, float switch and pump along with a heat exchanger to preheat domestic hot water make-up. Feasibility is limited to areas local to the dish washing facility.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|---|-----------|
| Heating Energy Savings Per Year: 3188 MBTU | \$ 11,127 |
| Electricity Savings Per Year: -10 MBTU | \$ - 196 |
| Maintenance Savings | \$ 0 |
| Total Savings Per Year: | \$ 10,931 |
| Total Construction Cost: | \$ 43,960 |
| Simple Payback (YRS): | 4.02 |
| SIR: | 4.41 |

FORT LEONARD WOOD
CONTRACT DACA41-85-C-0112

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 31

WASTE HEAT RECOVERY

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------|--------|-------|-----------------|-----------------|----------------|--------|------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYOUT | SIR |
| 657 | 0 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 657 | 7 | 1594.18 | 0.00 | 0.00 | -4.86 | \$5464 | 0 | \$21,980 | 4.02 | 4.41 |
| 735 | 0 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 821 | 0 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 1010 | 0 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 1010 | 1 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 1750 | 0 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| 1750 | 1 | 227.74 | 0.00 | 0.00 | -0.69 | \$781 | 0 | \$3,140 | 4.02 | 4.41 |
| Total | | 3188.36 | 0.00 | 0.00 | -9.69 | \$10931 | 0 | \$43,960 | 4.02 | 4.41 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH)
to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 31 BUILDING LIST

630 , 653 , 657 , 735 , 739 , 749 , 754 , 820 ,
821 , 836 , 1010 , 1011 , 1740 , 1750

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #32: Chilled Water Storage

CURRENT SITUATION:

Some buildings have local chillers that provide cooling when central plant chillers are throttled to limit demand or are the sole source of chilled water.

Chilled water could be generated during off peak hours for use when electric demand is greatest. The chilled water would have to be kept at a usable temperature until it was called for.

Implementation of a chilled water storage project would not save energy in fact it could increase actual BTU consumption. It would save electric demand. The rate structure at Ft. Leonard Wood, with a 100% demand ratchet would allow full realization of demand savings.

PROPOSAL:

Install insulated underground storage tanks, piping and controls to provide chilled water for up to 4 hours continuously, after storage of that water for up to 8 hours.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

Electricity Demand Savings Per Year: \$ 21,403
0 MBTU

Total Construction Cost: \$ 70,356

Simple Payback (YRS): 3.29

SIR: 3.52
NON-ECIP

FORT LEONARD WOOD

ESOS

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 32

CHILLED WATER STORAGE

ECO LIFE: 25 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | ENERGY SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------|--------|-------|-------------------|-----------------|----------------|---------|-----|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 499 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 21403 | \$70,356 | 3.29 | 3.52 | *R |
| 821 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 11826 | \$54,033 | 4.57 | 2.53 | |
| 822 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 5287 | \$30,177 | 5.71 | 2.01 | |
| 312 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 7235 | \$41,937 | 5.80 | 1.99 | |
| 450 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 7304 | \$42,262 | 5.79 | 1.99 | |
| 500 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 5797 | \$41,724 | 7.20 | 1.60 | |
| 5050 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 4151 | \$30,177 | 7.27 | 1.58 | |
| 315 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 10794 | \$81,239 | 7.53 | 1.54 | |
| 1705 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 3791 | \$30,177 | 7.96 | 1.44 | |
| 4113 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 2655 | \$25,666 | 9.67 | 1.18 | |
| 4113 | 5 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 13275 | \$128,330 | 9.67 | 1.18 | |
| 741 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 3954 | \$39,135 | 9.90 | 1.16 | |
| Total | | 0.00 | 0.00 | 0.00 | 0.00 | \$0 97472 | \$615,213 | | | |

| | | | | | | | | | | |
|-------|---|------|------|------|------|----------|----------|-------|------|---|
| 318 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 2273 | \$27,815 | 12.24 | 0.93 | N |
| 319 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 2273 | \$27,815 | 12.24 | 0.93 | |
| 636 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | \$0 3154 | \$39,135 | 12.41 | 0.92 | |
| Total | | 0.00 | 0.00 | 0.00 | 0.00 | \$0 7700 | \$94,765 | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #33: Steam Trap Inspection/Replacement

CURRENT SITUATION:

Steam is used directly for space heating in several buildings at Fort Leonard Wood.

PROPOSAL:

Replace steam traps which are worn or malfunctioning. A regular steam trap maintenance program will eliminate live steam returning to the boiler and improve boiler efficiency, fuel economy, and equipment capacity.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|--|---------------|
| Fuel Savings Per Trap Per Year: # 6 Oil, Central Plant (MBTU/YR 29.57) | \$ 103 |
| Total Construction Cost Per Trap: | \$ 91 |
| Simple Payback (YRS): | .88 |
| SIR: (25 Yr Life per ECIP Guidance) (With conservative 7 Yr Life) | 19.97 6.81 |

Calculations are based on conservative figures for replacing one steam trap in a building with short hours of operation, using #6 oil (the least expensive fuel), and a high system efficiency. Actual savings can be expected to be higher for buildings have a more expensive fuel, longer hours of operation, or lower system efficiency.

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #34: Interlock kitchen ventilation to cooking equipment.

CURRENT SITUATION:

Mess-hall kitchen exhaust and make-up air units are currently turned on in the morning when the cooks arrive and remain on until they depart at night.

These ventilation units are actually only required when the apparatus (range, dishwasher, etc.,) they serve are in operation.

PROPOSAL:

Install an interlock system to power the kitchen equipment and their dedicated exhaust hood units when equipment they serve is in operation. Install time delay relays to provide a lag period after equipment shutdown to sufficiently purge the system.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

Heating Energy Savings Per Year: \$ 6,698
1919 MBTU

Electricity Savings Per Year: \$ 3,397
165 MBTU

Total Savings Per Year: \$ 10,095

Total Construction Cost: \$ 36,034

Simple Payback (YRS): 3.57

SIR: 3.03

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 34

INTERLOCK KITCHEN VENTS

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL | OTHER SAVING | PROJECT COST | SIMPLE PAYBACK | SIR |
|--------------------|-------------|-----------------------------------|------|------|--------|---------|-----------------|--------------|-------------------|------|
| 1750 | 0 | 421.17 | 0.00 | 0.00 | 31.26 | \$2113 | 0 | \$3,896 | 1.84 | 5.93 |
| 1750 | 1 | .421.17 | 0.00 | 0.00 | 31.26 | \$2113 | 0 | \$3,896 | 1.84 | 5.93 |
| 821 | 0 | 225.17 | 0.00 | 0.00 | 12.48 | \$1043 | 0 | \$3,896 | 3.74 | 4.59 |
| 657 | 0 | 72.70 | 0.00 | 0.00 | 7.14 | \$401 | 0 | \$1,948 | 4.86 | 2.20 |
| 657 | 7 | 508.90 | 0.00 | 0.00 | 49.97 | \$2804 | 0 | \$13,636 | 4.86 | 2.20 |
| 735 | 0 | 153.41 | 0.00 | 0.00 | 22.50 | \$998 | 0 | \$4,866 | 4.88 | 2.00 |
| 1010 | 0 | 58.39 | 0.00 | 0.00 | 5.24 | \$312 | 0 | \$1,948 | 6.24 | 1.73 |
| 1010 | 1 | 58.39 | 0.00 | 0.00 | 5.24 | \$312 | 0 | \$1,948 | 6.24 | 1.73 |
| Total | | 1919.30 | 0.00 | 0.00 | 165.09 | \$10096 | 0 | \$36,034 | 3.57 | 3.03 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site ÷ 11,600 Source BTU/KWH)
to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 34 BUILDING LIST

630 , 653 , 657 , 735 , 739 , 749 , 754 , 820 ,
821 , 836 , 1010 , 1011 , 1740 , 1750

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

ECO #35: Ventilation Fan Control

CURRENT SITUATION:

Ten Hundred series barracks have numerous ventilation fans that are in operation continuously.

Ventilation could be curtailed when the structures are unoccupied.

PROPOSAL:

Install control systems comprising timeclocks and manual switches to turn fans "OFF" when they are not required.

ECONOMICS:

The total costs, savings, Savings Investment Ratio (SIR) and simple payback are:

| | |
|--|--------|
| Electricity Savings Per Year: 43 MBTU | \$ 890 |
|--|--------|

| | |
|--------------------------|----------|
| Total Construction Cost: | \$ 2,107 |
|--------------------------|----------|

| | |
|-----------------------|------|
| Simple Payback (YRS): | 2.37 |
|-----------------------|------|

| | |
|------|------|
| SIR: | 3.62 |
|------|------|

ENERGY SAVING OPPORTUNITY STUDY

INDIVIDUAL ENERGY CONSERVATION OPPORTUNITY SAVINGS SUMMARY

ECO NUMBER: 35

SHUT OFF VENT FANS

ECO LIFE: 15 YEARS

| BUILDING NUMBER | SIM BLDG | ***** MBTU SAVINGS PER YEAR ***** | | | | FUEL SAVINGS | OTHER SAVING | PROJECT SIMPLE | | |
|--------------------|-------------|-----------------------------------|--------|--------|-------|-----------------|-----------------|----------------|---------|------|
| | | #6 OIL | #2 OIL | LP GAS | ELECT | | | COST | PAYBACK | SIR |
| 1014 | 0 | 0.00 | 0.00 | 0.00 | 6.18 | \$127 | 0 | \$301 | 2.37 | 3.62 |
| 1014 | 5 | 0.00 | 0.00 | 0.00 | 30.89 | \$636 | 0 | \$1,505 | 2.37 | 3.62 |
| 1016 | 0 | 0.00 | 0.00 | 0.00 | 6.18 | \$127 | 0 | \$301 | 2.37 | 3.62 |
| Total | | 0.00 | 0.00 | 0.00 | 43.25 | \$890 | 0 | \$2,107 | 2.37 | 3.62 |

Note: Factor Electric MBTU/Yr Savings from calculation work sheets by (3,413 Site + 11,600 Source BTU/KWH) to equal the Site MBTU/Yr savings on this summary page and on the LCCA pages.

ECO 35 BUILDING LIST

1012 , 1013 , 1014 , 1015 , 1016 , 1028 , 1029

TABLE 1

Ft. Leonard Wood
Contract DACA41-85-C-0112

LIST OF BUILDINGS

ABBREVIATIONS:

| | | | |
|--------|-------------------------|-----------|----------------------------|
| M.H. | - Mess Hall | AD. & ST. | - Administration & Storage |
| B.H. | - Bachelor Housing | Maint. | - Maintenance |
| P.P. | - Power Plant | Train. | - Training |
| Hosp. | - Hospital | Ut. | - Utility Plant |
| Stor. | - Storage | Ed. | - Education |
| Oper. | - Operation | M.P. | - Multipurpose |
| Admin. | - Administration | C.Stor. | - Cold Storage |
| D.C. | - Dental Clinic | Latr. | - Latrine |
| M.O. | - Medical Orderly Rooms | D.K. | - Dog Kennel |

| BLDG. NUMBER | SQUARE FOOTAGE | FUNCTION | BLDG. NUMBER | SQUARE FOOTAGE | FUNCTION |
|-----------------|-------------------|--------------|-----------------|-------------------|----------|
| 185 | 1644 | U.T. | 1014 | 40639 | B.H. |
| 312 | 21594 | B.H. | 1016 | 40639 | B.H. |
| 315 | 42957 | Admin. | 1601 | 7664 | P.P. |
| 318 | 12174 | B.H. | 1608 | 12960 | D.C. |
| 319 | 12174 | B.H. | 1700 | 2341 | Stor. |
| 320 | 2617 | M.O. | 1701 | 23411 | Oper. |
| 450 | 12056 | Chapel | 1703 | 19096 | Oper. |
| 499 | 40635 | Ed. | 1705 | 7930 | Admin. |
| 500 | 14569 | D.C. | 1720 | 24667 | B.H. |
| 562 | 2400 | B.H. | 1724 | 11343 | B.H. |
| 565 | 2400 | Latr. | 1750 | 12929 | M.H. |
| 628 | 40640 | B.H. | 1766 | 11343 | B.H. |
| 636 | 9236 | Oper. | 1769 | 24667 | B.H. |
| 655 | 12134 | AD. & ST. | 2240 | 1308 | D.K. |
| 657 | 13280 | M.H. | 2250 | 1862 | Maint. |
| 672 | 4786 | Maint. | 2317 | 6510 | C.Stor. |
| 734 | 12155 | AD. & ST. | 2347 | 6510 | C.Stor. |
| 735 | 13280 | M.H. | 2348 | 6510 | C.Stor. |
| 740 | 6163 | Admin. | 2395 | 2600 | Stor. |
| 741 | 9236 | Oper. | 2399 | 2126 | Hosp. |
| 743 | 3700 | Hosp. | 4102 | 22003 | B.H. |
| 747 | 40640 | B.H. | 4113 | 11430 | B.H. |
| 780 | 4786 | Maint. | 5050 | 7436 | Train. |
| 801 | 17012 | Audio Visual | 5052 | 14480 | Train. |
| 818 | 40640 | B.H. | 5053 | 29225 | Maint. |
| 821 | 13280 | M.H. | 5074 | 32044 | Ed. |
| 822 | 6163 | Oper. | 5122 | 1800 | Train. |
| 823 | 12155 | Admin. | 5150 | 12667 | Train. |
| 1006 | 12155 | Admin. | 5231 | 1700 | M.P. |
| 1008 | 6163 | Oper. | 10250 | 2546 | Ut. |
| 1010 | 11316 | M.H. | | | |

TABLE 2

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 185 | | | | | | X | | X | X | | | | | X | | | | |
| 312 | X | | | X | X | X | | X | | | X | X | | | | | | |
| 315 | X | | | X | | | | X | | | X | X | | | | | | |
| 318 | | | | X | | | | X | | | X | X | | | | | | |
| 319 | | | | X | | | | X | | | X | X | | | | | | |
| 320 | | | | | X | | | | | | | | | | | | | |
| 450 | | | | X | | X | | X | | | | | | | | | | |
| 499 | X | | | X | | X | | X | | | | | | | | | | |
| 500 | | | | | X | X | | | | | X | X | | | | | | |
| 561 | | X | X | | X | | | | | | | | | | | | | |
| 562 | | X | X | | X | | | | | | | | | | | | | |
| 563 | | X | X | | X | | | | | | | | | | | | | |
| 564 | | X | X | | X | | | | | | | | | | | | | |
| 565 | | X | X | | X | | | | | | | | | | | | | |
| 565 | | X | X | | X | X | | | | | | | | | | | | |
| 566 | | X | X | | X | | | | | | | | | | | | | |
| 567 | | X | X | | X | | | | | | | | | | | | | |
| 568 | | X | X | | X | X | | | | | | | | | | | | |
| 569 | | X | X | | X | | | | | | | | | | | | | |
| 625 | X | | | | | X | | X | | | | X | | | | | | |
| 626 | X | | | | | X | | | | | | | | | | | | |
| 627 | X | | | | | X | X | X | | | X | X | | X | | | | |
| 628 | X | | | | | X | X | X | | | X | X | | X | | | | |
| 629 | X | | | | | X | X | X | | | X | X | | X | | | | |
| 630 | X | | | | | X | | X | | | X | | | X | X | | X | |
| 631 | X | | | | | X | | X | | | X | | | | | | | |
| 633 | X | | | | | X | | | | | | | | | | | | |
| 634 | X | | | | | X | | X | | | X | X | | X | | | | |
| 635 | X | | | | | X | | X | | | X | X | | X | | | | |
| 636 | X | | | | | | X | | | | | | | | | | | |
| 638 | X | | | | | X | | X | | | X | | | | | | | |
| 650 | X | | | | | X | | X | | | X | | | | | | | |
| 651 | X | | | | | X | | X | | | X | X | | X | | | | |
| 652 | X | | | | | X | | X | | | X | X | | X | | | | |
| 653 | X | | | | | X | | X | | | X | | | X | X | | | |
| 654 | X | | | | | X | | X | | | X | X | | X | | X | | |

TABLE 2

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 655 | X | | | | | X | | | | | | | | | | | | |
| 656 | X | | | | | X | | | | | | | | | | | | |
| 657 | X | | | | X | X | | X | | | X | | | X | X | | X | |
| 658 | X | | | | | X | | X | | | X | | | | | | | |
| 659 | X | | | | | X | | X | | | X | X | | X | | | | |
| 660 | X | | | | | X | | X | | | X | X | | X | | | | |
| 664 | | X | X | | X | | | | | | | | | | | | | |
| 665 | | X | X | | X | | | | | | | | | | | | | |
| 666 | | X | X | | X | | | | | | | | | | | | | |
| 667 | | X | X | | X | | | | | | | | | | | | | |
| 668 | | X | X | | X | | | | | | | | | | | | | |
| 669 | | X | X | | X | | | | | | | | | | | | | |
| 672 | | | | | | X | | | X | | | | | X | | | | |
| 673 | | | | | | | X | | | X | | | | X | | | | |
| 680 | | | | | | | X | | | X | | | | X | | | | |
| 681 | | | | | | | | X | | | X | | | | X | | | |
| 686 | | X | X | | X | | | | | | | | | | | | | |
| 687 | | X | X | | X | | | | | | | | | | | | | |
| 688 | | X | X | | X | | X | | | | | | | | | | | |
| 689 | | X | X | | X | | | | | | | | | | | | | |
| 690 | | X | X | | X | | | | | | | | | | | | | |
| 691 | | X | X | | X | | | | | | | | | | | | | |
| 692 | | X | X | | X | | | | | | | | | | | | | |
| 693 | | X | X | | X | | | | | | | | | | | | | |
| 694 | | X | X | | X | | | | | | | | | | | | | |
| 701 | | X | X | | X | | | | | | | | | | | | | |
| 702 | | X | X | | X | | | | | | | | | | | | | |
| 703 | | X | X | | X | | X | | | | | | | | | | | |
| 704 | | X | X | | X | | | | | | | | | | | | | |
| 705 | | X | X | | X | | | | | | | | | | | | | |
| 706 | | X | X | | X | | | | | | | | | | | | | |
| 707 | | X | X | | X | | | | | | | | | | | | | |
| 709 | | X | X | | X | | | | | | | | | | | | | |
| 710 | | X | X | | X | | | | | | | | | | | | | |
| 711 | | X | X | | X | | | | | | | | | | | | | |
| 712 | | X | X | | X | | | | | | | | | | | | | |

TABLE 2

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 713 | X | X | | X | | X | | | | | | | | | | | | |
| 714 | X | X | | | X | | | | | | | | | | | | | |
| 715 | X | X | | | X | | | | | | | | | | | | | |
| 716 | X | X | | X | | | | | | | | | | | | | | |
| 717 | X | X | | | X | | | | | | | | | | | | | |
| 718 | X | X | | | X | | | | | | | | | | | | | |
| 719 | X | X | | X | | | | | | | | | | | | | | |
| 720 | X | X | | | X | | | | | | | | | | | | | |
| 721 | X | X | | | X | | | | | | | | | | | | | |
| 722 | X | X | | X | | X | | | | | | | | | | | | |
| 723 | X | X | | | X | | | | | | | | | | | | | |
| 724 | X | X | | | X | | | | | | | | | | | | | |
| 725 | X | X | | X | | | | | | | | | | | | | | |
| 726 | X | X | | | X | | | | | | | | | | | | | |
| 727 | X | X | | | X | | | | | | | | | | | | | |
| 728 | | X | X | | X | | | | | | | | | | | | | |
| 730 | X | | | | | X | | X | | | X | X | | X | | | | |
| 731 | X | | | | | X | | X | | | X | X | | X | | | | |
| 732 | X | | | | X | | X | | | X | | | | | | | | |
| 733 | X | | | | X | | | | | | | | | | | | | |
| 734 | X | | | | X | | | | | | | | | | | | | |
| 735 | X | | | | | X | | X | | | X | | | X | | X | | X |
| 736 | X | | | | | X | | X | | | X | X | | X | | | | |
| 738 | X | | | | | X | | X | | | X | X | | X | | | | |
| 739 | X | | | | | X | | X | | | X | | | X | X | | X | |
| 740 | X | | | | | X | | X | | | X | | | | | | | |
| 741 | X | | | | | X | | X | | | | | | | | | | |
| 743 | X | | | | X | X | | X | | | X | | | | | | | |
| 747 | X | | | | | | X | | | | | X | | | | | | |
| 748 | X | | | | | X | | X | | | X | X | | X | | | | |
| 749 | X | | | | | | X | X | | | X | | | X | X | | X | |
| 750 | X | | | | | | X | X | | | X | | | | | | | |
| 751 | X | | | | | | X | | | | | | | | | | | |
| 752 | X | | | | | | X | | | | | | | | | | | |
| 753 | X | | | | | | X | | X | | | X | | | | | | |
| 754 | X | | | | | | X | | X | | | X | | | X | | | X |

TABLE 2

ECO/BUILDING MATRIX

| BUILDING | ENERGY CONSERVATION MEASURES | | | | | | | | | | | | | | | | | |
|----------|------------------------------|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
| 755 | X | | | | | X | | X | | X | X | | X | | | | | |
| 756 | X | | | | | X | | X | | X | X | | X | | | | | |
| 758 | | X | X | X | | | | | | | | | | | | | | |
| 759 | | X | X | X | | | | | | | | | | | | | | |
| 760 | | X | X | X | | X | | | | | | | | | | | | |
| 761 | | X | X | X | | | | | | | | | | | | | | |
| 762 | | X | X | X | | | | | | | | | | | | | | |
| 763 | | X | X | X | | | | | | | | | | | | | | |
| 764 | | X | X | X | | | | | | | | | | | | | | |
| 765 | | X | X | X | | | | | | | | | | | | | | |
| 766 | | X | X | X | | | | | | | | | | | | | | |
| 772 | | | | | X | | | X | | | | | | X | | | | |
| 773 | | | | | | X | | | | X | | | | | X | | | |
| 780 | | | | | | X | | | | X | | | | | X | | | |
| 781 | | | | | | X | | | | X | | | | | X | | | |
| 790 | | X | X | X | | | | | | | | | | | | | | |
| 791 | | X | X | X | | | | | | | | | | | | | | |
| 792 | | X | X | X | | X | | | | | | | | | | | | |
| 793 | | X | X | X | | | | | | | | | | | | | | |
| 794 | | X | X | X | | | | | | | | | | | | | | |
| 795 | | X | X | X | | | | | | | | | | | | | | |
| 796 | | X | X | X | | | | | | | | | | | | | | |
| 797 | | X | X | X | | | | | | | | | | | | | | |
| 798 | | X | X | X | | | | | | | | | | | | | | |
| 801 | | X | X | X | | | | | | | | | | | | | | |
| 806 | | X | X | X | | | | | | | | | | | | | | |
| 807 | | X | X | X | | | | | | | | | | | | | | |
| 808 | | X | X | X | | | | | | | | | | | | | | |
| 809 | | X | X | X | | | | | | | | | | | | | | |
| 810 | | X | X | X | | | | | | | | | | | | | | |
| 811 | | X | X | X | | X | | | | | | | | | | | | |
| 812 | | X | X | X | | | | | | | | | | | | | | |
| 813 | | X | X | X | | | | | | | | | | | | | | |
| 814 | | X | X | X | X | | | | | | | | | | | | | |
| 815 | X | | | | | X | | X | | X | X | | X | | | | | |
| 816 | X | | | | | X | | X | | X | X | | X | | | | | |

TABLE 2

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 817 | X | | | | | X | | | | X | X | | X | | | | | |
| 818 | X | | | | | | X | | | | X | | | | | | | |
| 819 | X | | | | | X | | X | | X | X | | X | | | | | |
| 820 | X | | | | | X | | X | | | X | | | X | X | | X | |
| 821 | X | | | | | | X | X | | | X | | | X | X | | X | |
| 822 | X | | | | | X | | X | | | X | | | | | | | |
| 823 | X | | | | | X | | | | | | | | | | | | |
| 824 | X | | | | | X | | | | | | | | | | | | |
| 825 | X | | | | | X | | X | | | X | | | | | | | |
| 827 | X | | | | | X | | X | | | X | X | | X | | | | |
| 828 | X | | | | | | X | X | | | X | X | | X | | | | |
| 829 | X | | | | | X | | X | | | X | X | | X | | | | |
| 830 | X | | | | | | X | X | | | X | X | | X | | | | |
| 831 | X | | | | | | X | X | | | X | X | | X | | | | |
| 832 | X | | | | | | X | X | | | X | | | | | | | |
| 836 | X | | | | | | X | X | | | X | | | X | X | | X | |
| 838 | X | | | | | | X | X | | | X | | | | | | | |
| 840 | X | | | | | | X | | | | | | | | | | | |
| 841 | X | | | | | | X | | | | | | | | | | | |
| 842 | X | | | | | | | X | | | | | | | | | | |
| 851 | | X | X | X | | | | | | | X | | | | | | | |
| 852 | | X | X | X | | | | | | | | | | | | | | |
| 853 | | X | X | X | | X | | | | | | | | | | | | |
| 854 | | X | X | X | | | | | | | | | | | | | | |
| 855 | | X | X | X | | | | | | | | | | | | | | |
| 856 | | X | X | X | | | | | | | | | | | | | | |
| 857 | | X | X | X | | | | | | | | | | | | | | |
| 858 | | X | X | X | | | | | | | | | | | | | | |
| 859 | | X | X | X | | | | | | | | | | | | | | |
| 990 | | | | | | X | | | X | | | | | X | | | | |
| 991 | | | | | | | X | | | X | | | | X | | | | |
| 998 | | | | | | | X | | | X | | | | X | | | | |
| 999 | | | | | | | X | | | X | | | | X | | | | |
| 1006 | X | | | | | | X | | | | | | | | | | | |
| 1007 | X | | | | | | X | | | | | | | | | | | |
| 1008 | X | | | | | | X | | X | | X | | | | | | | |

FORT LEONARD WOO
CONTRACT NO DACA41-85-C-011

TABLE 2

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 1009 | X | | | | | X | | | | X | | | | | | | | |
| 1010 | X | | | X | X | | | | | X | X | | | X | | X | | |
| 1011 | X | | | | X | | | | | X | X | | | X | | X | | |
| 1012 | X | | | | | X | | | | | X | | | | | | | X |
| 1013 | X | | | | | X | | | | | X | | | | | | X | |
| 1014 | X | | | X | | X | | | | | X | | | | | | X | |
| 1015 | X | | | | | X | | | | | X | | | | | | X | |
| 1016 | X | | | | | X | | | | | X | | | | | | X | |
| 1018 | X | | | X | | X | | | | X | | | | | | | X | |
| 1025 | X | | | | X | | | | | | | | | | | | | |
| 1028 | X | | | | | X | | | | | X | | | | | | | X |
| 1029 | X | | | | | X | | | | | X | | | | | | X | |
| 1601 | X | | X | X | | | X | | | | | | | | | | | |
| 1608 | | | X | X | X | | X | | | | | | | | | | | |
| 1700 | | | X | | | X | X | | | | | | | | | | | |
| 1701 | | | | | | | X | | | | | | | | | | | |
| 1702 | | | | | | | X | | | | | | | | | | | |
| 1703 | | | | | | | X | | | | X | X | | | | | | |
| 1704 | | | | | | | X | | | | X | X | | | | | | |
| 1705 | | | | | | | X | | | | X | | | | | | | |
| 1706 | | | | | | | X | | | | | | | | | | | |
| 1707 | | | | | X | X | | X | | | | | | | | | | |
| 1720 | | | | | X | X | | | | | | X | | | | | | |
| 1722 | | | | | X | | | | | | | X | | | | | | |
| 1723 | | | | | | X | | | | | | X | | | | | | |
| 1724 | | | | | X | | | | | | | X | | | | | | |
| 1725 | | | | | X | | | | | | | X | | | | | | |
| 1726 | | | | | | X | | | | | | X | | | | | | |
| 1728 | | | | | | X | | | | | | X | | | | | | |
| 1729 | | | | | | X | | | | | | X | | | | | | |
| 1730 | | | | | | | X | | | | | X | | | | | | |
| 1731 | | | | | | | X | | | | | X | | | | | | |
| 1732 | | | | | | X | | | | | | X | | | | | | |
| 1733 | | | | | | | X | | | | | X | | | | | | |
| 1734 | | | | | | | X | | | | | X | | | | | | |
| 1735 | | | | | | X | | | | | | X | | | | | | |

TABLE 2

FORT LEONARD WOO
CONTRACT NO DACA41-85-C-011

ECO/BUILDING MATRIX

ENERGY CONSERVATION MEASURES

| BUILDING | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 | 35 |
|----------|---|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 1740 | | | | | | | X | | | X | X | | X | X | | | X | |
| 1750 | | | | | X | | | X | | X | X | | X | X | | | X | |
| 1761 | | | | | | X | | | | | X | | | | | | | |
| 1762 | | | | | | | X | | | | | X | | | | | | |
| 1763 | | | | | | | X | | | | | X | | | | | | |
| 1764 | | | | | | | X | | | | | X | | | | | | |
| 1765 | | | | | | | X | | | | | X | | | | | | |
| 1766 | | | | | | | X | | | | | X | | | | | | |
| 1767 | | | | | | | X | | | | | X | | | | | | |
| 1768 | | | | | | | X | | | | | X | | | | | | |
| 1769 | | | | | | | X | | | | | X | | | | | | |
| 1771 | | | | | | | X | | | | | X | | | | | | |
| 1773 | | | | | | | X | | | | | X | | | | | | |
| 1774 | | | | | | | X | | | | | X | | | | | | |
| 1775 | | | | | | | X | | | | | X | | | | | | |
| 1776 | | | | | | | X | | | | | X | | | | | | |
| 2240 | | | | | | | | X | | | | | | | | | | |
| 2250 | | | | | | | X | | | | | | | | | | | |
| 2317 | | | | | | | | | | | | | | | | | | |
| 2347 | | | | | | | | | | | | | | | | | | |
| 2348 | | | | | | | | | | | | | | | | | | |
| 2395 | | | | | | | X | | | | | X | | | | | | |
| 2399 | | | | | | | X | | | | | X | | | | | | |
| 4100 | X | | | | | | X | | | | | X | | | X | | | |
| 4101 | X | | | | | | X | | | | | | | | | | | |
| 4102 | X | | | | | | X | | | | | | | | | | | |
| 4103 | X | | | | | | X | | | | | | | | | | | |
| 4104 | X | | | | | | X | | | | | | | | | | | |
| 4110 | | | | | | | | X | | | | | | | | | | |
| 4111 | | | | | | | | X | | | | | | | | | | |
| 4112 | | | | | | | | X | | | | | | | | | | |
| 4113 | | | | | | | | X | | | | | | | | | | |
| 4114 | | | | | | | | X | | | | | | | | | | |
| 4115 | | | | | | | | | X | | | | | | | | | |
| 5050 | | | | | | | | | X | | | | | | | | | |
| 5052 | | | | | | | | | X | | | | | | | | | |

TABLE 2

FORT LEONARD WOO
CONTRACT NO DACA41-85-C-011

ECO/BUILDING MATRIX

| BUILDING | ENERGY CONSERVATION MEASURES | | | | | | | | | | | | | | | | |
|----------|------------------------------|----|----|---|---|----|-----|----|----|----|----|----|----|----|----|----|----|
| | 1 | 1A | 1B | 2 | 7 | 10 | 11X | 12 | 14 | 15 | 16 | 18 | 21 | 23 | 31 | 32 | 34 |
| 5053 | | | | X | | X | X | | X | | | | | | | | |
| 5074 | | | | X | X | | X | | X | | | | | | | | |
| 5122 | | | | | | | X | | X | | X | | | | | | |
| 5130 | | | | | | | | | X | | | | | | | | |
| 5150 | | | | | | | | | X | | | | | | | | |
| 5161 | | | | X | | | | | X | | | | X | | | | |
| 5169 | | | | | | | | X | | | | | | | | | |
| 5231 | | | | | | | | X | | | | | | | | | |
| 5301 | | | | | | | X | | | | | | | | | | |
| 5334 | | | | | | | X | | | | | | | | | | |
| 5346 | | | | | | | X | | | | | | | | | | |
| 5350 | | | | | | | X | | | | | | | | | | |
| 5361 | | | | | | | | X | | | | | | | | | |
| 5374 | | | | | | | | X | | | | | | | | | |
| 5391 | | | | | | | | X | | | | | | | | | |
| 5500 | | | | | | | | | X | | | | | | | | |
| 5511 | | | | | | | | | X | | | | | | | | |
| 5531 | | | | | | | | | X | | | | | | | | |
| 5592 | | | | | | | | | | X | | | | | | | |
| 5702 | | | | | | | | | | X | | | | | | | |
| 5732 | | | | | | | | | | X | | | | | | | |
| 5743 | | | | | | | | | | X | | | | | | | |
| 10250 | | | | | | | | | | X | | | | | | | |

FORT LEONARD WOOD
CONTRACT NO DACA41-85-C-0112

TABLE 3

COMPLETE BUILDING LIST

ALL STUDIED AND SIMILAR BUILDINGS

| | | | | | |
|-----|-----|-----|------|------|-------|
| 185 | 668 | 734 | 811 | 1013 | 1775 |
| 312 | 669 | 735 | 812 | 1014 | 1776 |
| 315 | 672 | 736 | 813 | 1015 | 2240 |
| 318 | 673 | 738 | 814 | 1016 | 2250 |
| 319 | 680 | 739 | 815 | 1018 | 2317 |
| 320 | 681 | 740 | 816 | 1025 | 2347 |
| 450 | 686 | 741 | 817 | 1028 | 2348 |
| 499 | 687 | 743 | 818 | 1029 | 2395 |
| 500 | 688 | 747 | 819 | 1601 | 2399 |
| 561 | 689 | 748 | 820 | 1608 | 4100 |
| 562 | 690 | 749 | 821 | 1700 | 4101 |
| 563 | 691 | 750 | 822 | 1701 | 4102 |
| 564 | 692 | 751 | 823 | 1702 | 4103 |
| 565 | 693 | 752 | 824 | 1703 | 4104 |
| 565 | 694 | 753 | 825 | 1704 | 4110 |
| 566 | 701 | 754 | 827 | 1705 | 4111 |
| 567 | 702 | 755 | 828 | 1706 | 4112 |
| 568 | 703 | 756 | 829 | 1707 | 4113 |
| 569 | 704 | 758 | 830 | 1720 | 4114 |
| 625 | 705 | 759 | 831 | 1722 | 4115 |
| 626 | 706 | 760 | 832 | 1723 | 5050 |
| 627 | 707 | 761 | 836 | 1724 | 5052 |
| 628 | 709 | 762 | 838 | 1725 | 5053 |
| 629 | 710 | 763 | 840 | 1726 | 5074 |
| 630 | 711 | 764 | 841 | 1728 | 5122 |
| 631 | 712 | 765 | 842 | 1729 | 5130 |
| 633 | 713 | 766 | 851 | 1730 | 5150 |
| 634 | 714 | 772 | 852 | 1731 | 5161 |
| 635 | 715 | 773 | 853 | 1732 | 5169 |
| 636 | 716 | 780 | 854 | 1733 | 5231 |
| 638 | 717 | 781 | 855 | 1734 | 5301 |
| 650 | 718 | 790 | 856 | 1735 | 5334 |
| 651 | 719 | 791 | 857 | 1740 | 5346 |
| 652 | 720 | 792 | 858 | 1750 | 5350 |
| 653 | 721 | 793 | 859 | 1761 | 5361 |
| 654 | 722 | 794 | 990 | 1762 | 5374 |
| 655 | 723 | 795 | 991 | 1763 | 5391 |
| 656 | 724 | 796 | 998 | 1764 | 5500 |
| 657 | 725 | 797 | 999 | 1765 | 5511 |
| 658 | 726 | 798 | 1006 | 1766 | 5531 |
| 659 | 727 | 801 | 1007 | 1767 | 5592 |
| 660 | 728 | 806 | 1008 | 1768 | 5702 |
| 664 | 730 | 807 | 1009 | 1769 | 5732 |
| 665 | 731 | 808 | 1010 | 1771 | 5743 |
| 666 | 732 | 809 | 1011 | 1773 | 10250 |
| 667 | 733 | 810 | 1012 | 1774 | |